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ADVANCED MATERIALS

France: Bertin Develops 'Smart' Material

91AN0428 Paris SCIENCES & AVENIR in French May 91 p 11

[Text] A material that warns when it is deforming! The information could prove to be of capital importance. In aeronautics, for instance, control operations occur only every three to six months during general inspections. Each structure is carefully checked by X-ray or acoustic test equipment.

With this "intelligent" material, Bertin seeks to ease the work of aircraft manufacturers and architects by simplifying these cumbersome periodical inspections. The new technology consists of innervating the structural parts with embedded optical fibers. Any deformation or heating of the material results in a modification of the light signal passing through the optical fiber and causes a perturbation that can immediately be seen on the terminal to which the fiber is connected. Thus, maps of any structural defects occuring during an aircraft's or work of art's lifetime will be readily available. Since defect detection is done on a permanent basis, any embrittlement of the part can be detected in real time.

France: Cheap Crystal Growth Technology Developed

91AN0429 Paris SCIENCES & AVENIR in French May 91 p 11

[Text] Physicists from the University of Paris-VI and the National Center for Scientific Research (CNRS) have succeeded in growing high-quality crystals under high gravity. Placed in a centrifugal machine, the liquid to be crystallized produced a material with a particularly homogeneous composition. Up to now, such results could only be obtained in microgravity. This experiment puts the finishing touch to research started 6 years ago by Huguette Rodot from CNRS and Alain Chevy from the Solid-State Physics Laboratory at the University of Paris-VI. To demonstrate the efficiency of their method, the two researchers produced a material of high technological value: a semiconducting monocrystal of germanium doped with gallium, a well known material because it led to the construction of the first transistors. The quality of the material obtained by the two French researchers is comparable to that of materials produced in space at high cost. This constitutes significant progress, since this kind of experiment on board a satellite costs much more than the purchase of a centrifuge.

France: Strong Fireproof Glass Foam Developed

91AN0364 Paris SCIENCES & AVENIR in French Apr 91 p 11

[Text] A new material is born: Innolithe. It was developed by Yves Laurent's team at the University of Rennes' laboratory for solid-state and inorganic molecular chemistry which is associated with the National Center for Scientific Research (CNRS). The Rennes researchers made their discovery while studying the behavior of certain types of glass at high temperature: At about 1,000 degrees centigrade, molten glass releases nitrogen in gaseous form, and a glass foam is obtained. After cooling, it becomes an expanded material, somewhat like a souffle. The Rennes specialists had the idea of using salvaged glass (sold at approximately 350 French francs per tonne) as raw material. Once it is crushed, a nitrogenous compound, aluminum nitride, is added. The result closely resembles pumice, but with much more interesting properties: Unlike most insulators, Innolithe boasts excellent resistance to mechanical stress. It is noncombustible, does not produce any toxic fumes, and does not feed combustion by destroying itself. It can withstand temperatures of up to 800 degrees centigrade, as compared to 200 degrees for certain competiting materials such as phenolic resins. In a sandwich structure with metallic elements, it has proved to be a very good fireproof barrier.

In cooperation with the firm Kaolins d'Arvor, a new company was created near Lorient to prepare and launch industrial production within the next 2 years. Applications of this (unfortunately very costly) insulator range from coating for factory chimneys, building facades, and industrial piping to naval equipment, not to mention military applications that are still highly confidential for the time being.

German University Develops Anticorrosion Coating

91MI0339 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 17 Apr 91 p 4

[Text] Chemists at Duisburg University have developed a completely new process whereby service metals [Gebrauchsmetalle] are coated with a conductive synthetic metal film that protects them primarily against corrosion. Electrodeposition is used in this process. The major areas of application for this new electrical surface treatment and coating technology are corrosion protection and material economy.

The process for coating gold, platinum, or glass carbon [Glaskohlenstoff] with synthetic metals by electrodeposition is well known. However, service metals such as steel, aluminum, or copper present greater difficulties, as they can decompose during electrolysis. Prof. Fritz Beck's team at Duisburg University was able to solve this problem with a new process that precisely defines the pretreatment of the workpiece to be coated, the composition of the electrolytic bath, the deposition conditions, and subsequent treatment. In practice, coating with synthetic metals brings many advantages, as the coatings are air-resistant, do not melt, and are insoluble in the common solvents.

They absorb light and other radiation, are conductive, and often have excellent adhesion. The new method of coating service metals with synthetic metals has a wide variety of potential applications:

- corrosion protection: use as intermediate layer;
- top coatings using metals or cathodic dipping varnishes made possible by the conductivity of the layers;

- functional coatings on account of the high heat radiation absorption by the layers.

The process, which still requires further development, is funded by the German Research Association, the North Rhine-Westphalia Ministry of Science and Research, and the Federation of Industrial Research Associations (AiF). A joint venture is also under way with BASF AG in Muenster-Hiltrup.

AEROSPACE

1992 International Space Year Conference Planned

91MI0360 Rome AIR PRESS in Italian 29 May 91 p 1145

[Text] The final conference of "International Space Year," scheduled for early 1992 in Italy and organized by the ASI (Italian Space Agency) will be part of the Columbus celebrations in Genoa. The decision was made at the fourth SAFISY (the organization of world space agencies for the management of International Space Year) forum held in Moscow following a proposal by Senator Giovanni Urbani of the ASI (a member of the board of directors) and Professor Sergio Vetrella (from the scientific commitee). The theme selected by SAFISY is "Space Discoveries at the Service of the Global Safety of the Planet Earth." Each participating nation will develop one specific aspect of this theme. Italy has chosen the sector concerning the contribution of space in preventing and providing assistance in natural disasters.

The Eurospace workshop also took place in conjunction with the fourth SAFISY forum in Moscow. This workshop, organized by the Association of European Aerospace Industries and its Soviet conterpart ICAS Cosmos, dealt with "European and Soviet Comparisons of the Space Industry." Senator Urbani represented the ASI at the workshop while the representatives from Italian industries were Alenia Spazio president, Professor Ernesto Vallerani, and Telelespazio president, Engineer Roberto Panella. Vallerani, accompanied by Engineer Giuseppe Viriglio, presented a report on manned space systems, entitled "Orbiting Infrastructures of the Future." Other reports were presented by experts from Telespazio: G. Apponi (remote surveying), F. Scueglia (on business TV via satellite), and C. Marcolin (telecommunications via satellite). The meeting highlighted the new market prospects for Italian-Soviet collaboration, and the mutual interest in investigating these prospects "by identifying," an ASI release stated, "appropriate regulations and funding." One of the Italians present at the meeting indicated that the Soviets demonstrated their interest in presenting and sharing their technologies. It was openly admitted that the USSR does not have the funds to continue its research nor will it have any in the years to come. For this reason there is a lively interest in reaching collaboration agreements with western nations, in all sectors of space activity.

France: Telecom-2 Satellite System Described

91AN0491 Paris SCIENCES & AVENIR in French Jul 91 p 18

[Article by Albert Ducrocq: "The Telecom-2 Program"]

[Text] The Telecom-2 program was introduced on 7 June. With a budget of 7 billion French francs—60 percent funded by France Telecom and 40 percent by the General Armaments Delegation (DGA) (each Telecom-2 will in effect have a military telecommunications mission due to a Syracuse [satellite communications system] payload—the Telecom-2 project consists of three satellites designed to replace the Telecom-1 system but with a much greater capacity: a life expectancy of seven to 10 years thanks to the larger fuel reserves; 26 transponders instead of 12; and a mass of 2,145 kg, compared to 1,210 kg for Telecom-1.

Telecom-2A will be put into orbit in order to be operational for the opening of the Albertville Olympic Games in February 1992. It will be joined six months later by Telecom-2B (which will allow Telecom-1A, in operation since 1984, to be withdrawn from service), while Telecom-2C will serve as a backup satellite. In addition to ensuring communications between Paris and the overseas departments and territories, Telecom-2 will have multiple applications, including distribution of television programs, emergency or standby links, transmission of digital data, business videoconferencing, and most certainly all sorts of planetary communications. Pierre Godimiaux, head of the Telecom project, noted that without orbital communications France would be deprived of direct communications with 62 countries.

Aerospatiale Positions Itself for Year 2000

91WS0478A Paris L'USINE NOUVELLE in French 6 Jun 91 pp 16-20

[Article by Jean-Francois Jacquier: "How Aerospatiale Is Preparing for the Year 2000"; first paragraph is L'USINE NOUVELLE introduction]

[Text] European cooperation will not adequately provide for the future. The French want to take the Germans and the Italians along on the U.S. market before they can take on Japan.

It was barely past noon, local time, on 6 June 2005, when the landing gear of Alliance, the famous ATSF landed smoothly on the tarmac of the main runway at the Tokyo-Narita Airport. Since its takeoff at the Toulouse-Blagnac airport, just a little over five hours had elapsed. Thirty years after the Concorde, the first flight of the successor of the Franco-British supersonic aircraft inaugurated a new era in aeronautics, that of aircraft developed through worldwide cooperation.

Launched in the late nineties, the Alliance was the result of work performed jointly by U.S., European and Japanese manufacturers. Among their representatives on this flight 001, was the young Aerospatiale chief executive officer [CEO]. Aged 45, polyglot, he was neither a military man nor an armament engineer like his predecessors; he was

trained in the best international management schools. He got his practical training first at Deutsche Aerospace in Germany, then at McDonnell-Douglas in the United States before assuming control of the multinational company of French origin.

As he set foot on Japanese soil, on that historic day of the year 2005, he could not repress a moved thought for the pioneers of the French aeronautical industry. "They have come such a long way since the first steps of the Morane Saulnier, Louis Bleriot, Potez, Farman Hanriot, Marcel Bloch, and the dozen or so small regional companies which, after many regroupings and nationalizations, eventually formed Aerospatiale in 1970."

Now, in the early 21st century, the French national company has become a veritable international industrial holding. With industrial ramifications in the United States and in Asia. Certainly, the French State still holds a majority interest in the core of the holding, partly directly, partly through nationalized banking groups—because it remains the prime contractor for the French nuclear deterrent power. But one third of the Aerospatiale stock—99.97 percent of which used to be owned by the State—is now listed on the stock exchange.

Fiction? Even though they are very careful not to delineate the future as precisely as this, it is toward the implementation of such a scenario that the Aerospatiale management are now working: Aerospatiale, the leading French aerospace company, the third in Europe after British Aerospace and Deutsche Aerospace, and the 12th worldwide, with 1990 sales of close to 33 billion francs [Fr] and 33,500 employees.

Anticipating Trends

In the aerospace industry, where development and manufacturing cycles for military or civil equipment commonly spread over 20 or 30 years, trends must be anticipated a long time in advance. Now, as the president of the Republic is about to open the 39th Le Bourget show, on 13 June, the challenges that Aerospatiale must face are equal to those that the nation must face. The group will have to strengthen its European bases and, at the same time, it will be forced to develop an active policy of internationalization. It will have to step out of Europe into a market that is no longer French or European, but global.

At stake is whether France will continue to be represented in sectors as vital as communications (air transport and satellite telecommunications) or the defense industry (tactical and strategic nuclear missiles). The country's ability to be heard throughout the world depends on it. The stakes, therefore, are both strategic and economic.

A crucible for a large part of advanced technologies, the aeronautical industry is also a significant source of foreign currency. With over Fr18 billion (56 percent of its sales), Aerospatiale ranks eighth among French exporters. But, in order to retain an active role in the international concert and get its share of the world market, estimated at $2,000 billion (civil and military markets together) by the year 2000, Aerospatiale will have to sacrifice some of its prestige and sovereignty.

After carrying France's De Gaullian technological ambitions in the sixties and seventies (as illustrated by the Concorde), after assuming the aeronautical leadership of Europe in the seventies and eighties (with Ariane and Airbus), the group will have to accelerate its internationalization in the nineties, even if that means reducing the scope of the activities it controls directly.

The cause of this strategic change is the formidable explosion of R&D and industrialization costs for the new programs of the years 2000-2010. "From now on, the accounting unit is Fr10,000," Yves Michot, Aerospatiale assistant general manager, noted. Thus a civil program like the Airbus A320 will require a total financing of some Fr20 billion. Ariane 5, which will launch the Hermes spacecraft at the end of the century, will gobble up Fr28 billion. The bill for the triad Ariane 5/Hermes/Columbus (the European orbital platform) will exceed Fr80 billion. And the development of a military helicopter like the future French-German Tiger will cost close to Fr10 billion.

Now, although Aerospatiale has accumulated over 30 years of experience with European cooperation—since 1958 when Nord Aviation and MBB [Messerschmitt-Boelkow-Blohm] launched the Transall—and although it shares risks with other partners in 55 percent of its activities, it still must invest the equivalent of 39 percent of its sales, i.e., Fr15 billion per year, in R&D and industrialization. That is far more than most of its competitors who, like Boeing, may benefit from economies of scale, as they work on projects that are sometimes four times bigger.

Certainly, as a lot of the equipment it makes (especially missiles and helicopters) will become outdated by the end of the century, Aerospatiale is busy renewing or expanding the product lines of each of its divisions (see data on future programs [below]) and is thus providing for its future.

"The danger would be to leave an aeronautical desert to the next generations," Henri Martre, Aerospatiale CEO, keeps repeating. But the company must also get ever bigger market shares in order to produce larger series and write off increasingly heavy launching costs. Traditional European cooperation by program is no longer enough. They must go beyond that.

The recent decision to merge the helicopter operations of Aerospatiale with those of Deutsche Aerospace (German Daimler-Benz group) is in line with this new strategy. The Tiger antitank helicopter, the prototype flight of which will be one of the highlights of Le Bourget Show, will be the first product of the new industrial group called Eurocopter. Because, this time (this is something quite new), the French and the Germans will really pool everything, without any distinction as to who contributed what: marketing resources, research, existing lines, future developments, and production centers.

To Prevent Waste

The advantage of such an arrangement is that, in theory, it should last "forever." "This is the only way to really prevent duplication in research," an Aerospatiale official explained. "In cooperations by program or program families that have been implemented in Europe until now, the distribution of production tasks was done mostly based on expertise. As a result, each partner was very careful not to show the other how he was doing it. This was wasteful. Eurocopter will not have this problem. There is only one cash register; what benefits one partner also benefits the other."

As the two manufacturers—which were not exactly eager to help each other in the past—are no longer competing with each other, they should also be able to increase their market share. Together, they can expect to have a considerable marketing impact, with 41 percent of the aircraft sold worldwide (not including the Soviet Union and the U.S. military market).

Paradoxically, the Aerospatiale helicopter division was the one least involved in cooperation: it accounted for only 18 percent of its activity, compared with 49 percent for tactical missiles, 52 percent for space systems, and 85 percent for aircraft. Therefore, there was both a need to develop cooperation and a situation relatively simpler than in the other divisions, making it easier to attempt a merger. Eventually, a common determination and market opportunities did the rest. In addition to the Tiger, which is purchased by France and Germany (427 units in all), they are looking forward to the launching of the NH-90, a tactical transport helicopter for NATO forces. Two military programs at the same time: something like that occurs only once every 20 years! Not to mention the fact that these programs will make it less expensive to develop a line of civil helicopters. Eurocopter, therefore, will serve as a test. If it succeeds, "we can well imagine that Airbus will follow suit, or rather that Aerospatiale and Deutsche Aerospace, the two main partners in the consortium, will decide to create a joint large-jet subsidiary," an official estimated. "But probably not before the introduction of the Airbus A350, the 700-seat superjumbo jet designed to compete with the Boeing 747 at the end of the century."

Future Workload Distribution

Already, the Toulouse and Munich plants have begun to achieve more rational flows between their respective assembly lines. With the introduction of the A321, it also looks as if a tacit agreement had been reached concerning future workload distribution: the Germans would assemble the 150-seaters and smaller aircraft; the French, the wide-body aircraft. This is confirmed by the fact that, early this year, Aerospatiale agreed to let Deutsche Aerospace become the prime contractor for the planned small 100-seat aircraft on which the national Italian company Alenia will also be working.

"In the next few years, we shall also have to coordinate our procurement policies, somewhat like Renault and Volvo are doing in the automobile sector. There is much to be gained by that," Jacques Teyssier, assistant general manager in charge of industrial matters at Aerospatiale, added. Actually, the company's European strategy is clearly heading for "progressive integration of industrial resources. This means giving up a lot," Jacques Battistella, industrial policy director, commented. This giving up, in most cases, will benefit Deutsche Aerospace, and also Alenia. It is as if the English of British Aerospace were no longer trusted. "In eight years, they have joined three of the 15 or 20 cooperative programs launched, never bought a single Airbus A320, and caused everybody to lose money with their four-month strike last year," a disgruntled official of the group explained.

True, the British remain very dependent on the Americans. In civil aviation, and in the military and many other sectors, including the cultural sector. But, "the Americans are our true adversaries," the Aerospatiale management furiously claims. "They monopolize 60 percent of the world aeronautical production, protect themselves with the dollar and interest rates, and have every intention to benefit from the political consequences of the Gulf War."

The French, therefore, decided to attack the fortress. Besides, they have no choice if they want to remain in the race. The U.S. market cannot be ignored. It accounts alone for 50 percent of the world market. And despite its honorable breakthroughs with U.S. airlines, the results achieved by Airbus are a far cry from its ambitions. However, Aerospatiale does not seem to have much of a chance against giants like Boeing, McDonnell-Douglas and United Technologies. Therefore, in exchange for the concessions made in Europe, the French leader expects unfailing support from the Germans and Italians on the American continent.

Thus, earlier this year, Aerospatiale and Alenia acquired a 49-percent interest in the Loral satellite manufacturer. They should soon be joined by Deutsche Aerospace, with whom the French are negotiating a strengthening of already existing relations in the satellite sector. Loral, for its part, is negotiating with Mitsubishi. If all goes well, we might witness the creation of the first truly global satellite manufacturer within one year. At the initiative of Aerospatiale.

The same line of reasoning led to the acquisition of De Havilland, the Canadian manufacturer of small aircraft (the Dash), which is currently being negotiated jointly with Alenia. If the Canadian authorities agree, it could all become part of International Commuter, a company that would also cover the French-Italian ATR and the new 100-seat aircraft proposed by the Germans.

With a definite lack of inhibitions, Henri Martre will even outline a still more daring future. Since anything goes when competing with the Americans, who he says are almost more protectionist than the Japanese, why not take advantage of Douglas's weaknesses on the civil aircraft market and, with the complicity of the Long Beach manufacturer, attack directly the monopoly of the Boeing 747? "We are talking it over with Douglas," the Aerospatiale CEO disclosed. As far as the successor of the Concorde is

concerned, he believes that it will have to be built in cooperation with the Europeans, the Americans and the Japanese. Even with Tupolev. "The greatest threat, the one we must counter at any price, is the U.S.-Japanese alliance of technology and financial power."

An Arms-Manufacturing Europe

In the year 2000, Aerospatiale will therefore exist as a worldwide company or not at all. The challenge will be harder to meet in the military sector, where European borders and sovereignties will represent obstacles. The Gulf War, however, might accelerate the edification of an arms-manufacturing Europe. Meanwhile, Aerospatiale does remain idle in this sector and multiplies traditional cooperations in the form of economic interest groups around new products such as the Aster, which might be the beginning of a European Patriot missile. For the time being, the only projects not covered by the internationalization strategy are those dealing with the modernization of the deterrent power.

One may wonder how the company will manage this unprecedented mutation which, lacking money, must rely on ingenuity and will lead to the creation of an industrial complex consisting of a multitude of economic interest groups, French and foreign subsidiaries, participations, etc. Is the company not risking to lose its identity? Already by 1993, according to projections, 80 percent of the expected Fr47 billion in sales will be achieved through European or international cooperation.

Under these conditions, how will it do to remain in control? First, at group level, by retaining upstream research and systematically giving preference to engineering projects that will benefit all divisions: aerodynamics, stealth, materials, etc. Then, by expanding its research on buoyant technologies: optronics, laser, ramjets, computer systems, etc. Above all, by not losing its footing in the military sector. All this expertise should be enhanced by Aerospatiale's specific ability to manage the most complex cooperation projects. An asset that is the result of over 30 years of experience in the field.

Managing human resources will be another way to remain in control. Out of 7,000 executives, about 1,000, having "corporate" status, will form a sort of praetorian guard protecting the group's interests. Interchangeable according to their expertise and the needs of the moment, they will be placed in subsidiaries to head off any problems.

For these extremely mobile executives, the most difficult will be to manage to extricate themselves from French culture, the better to fit in every case into the mold of internationalization.

"This is why at least 200 of them will have to be recruited outside France," Jacques Teyssier explained. One of them, perhaps, will be the future CEO of 2005 and beyond.

The Puzzle of Aerospatiale's International Cooperations
1990 Sales: Fr32.8 billion

Company	Partners or Co-Shareholders
Tactical Missiles 1990 sales: Fr6.3 billion	
Euromissile (Milan-Hot antitank, Roland ground-to-air, ANS antiship)	DASA [German Aerospace Agency]
EMDG, Euromissile Dynamics Group (Third-generation antitank missiles)	DASA (German), British Aerospace (Great-Britain)
Eurosam (Ground/surface-to-air Aster, antimissile missiles, intermediate-range missiles)	Alenia (Italy), Thomson-CSF (France)
MLRS EPG (Multiple-launch rocket system)	Diehl (Germany), Hunting (Great-Britain), BPD (Italy)
Strategic and Space Systems 1990 sales: Fr8.1 billion	
Satellites (All satellites)	Alcatel (France), Alenia (Italy)
Loral (U.S.) (Satellites)	Alenia (Italy), negotiations in progress with DASA (Germany) and Mitsubishi (Japan)
Arianespace (Ariane 4, Ariane 5)	Various European manufacturers
Eurohermespace (Hermes)	Alenia (Italy), DASA (Germany), Dassault Aviation (France)
Aircraft 1990 sales: Fr10.6 billion	
Airbus Industrie (A300, A320, A330, A310, A321, A340)	DASA (Germany), British Aerospace (Great-Britain), CASA [Spanish Aeronautical Engineering Company] (Spain)
Euroflag (Tactical military transport aircraft)	DASA (Germany), British Aerospace (Great-Britain), CASA (Spain), Alenia (Italy)

The Puzzle of Aerospatiale's International Cooperations
1990 Sales: Fr32.8 billion

Company	Partners or Co-Shareholders
De Havilland (Canada, acquisition in progress)	Alenia (Italy)
ATR (Commuter Aircraft) (ATR-42, ATR-72)	Alenia (Italy)
International Commuter (ATR subsidiary) (100-seater aircraft project)	DASA (Germany)
Helicopters 1990 sales: Fr7.8 billion	
Eurotiger (Tiger antitank helicopter)	DASA (Germany)
Eurocopter International (Marketing)TcDASA (Germany)	
NTH Industry (NH90, NATO helicopter)	DASA (Germany), Agusta (Italy), Fokker (Netherlands)

To meet Aerospatiale's development needs, cooperation on European programs (Euromissile, Airbus, Arianespace, etc.) is no longer enough. The company now must make this alliances more stable through mergers (Eurocopter) and gain a foothold in America (Loral, De Havilland) or even, later on, in Japan (Mitsubishi).

[Box, p 18]

Missiles: The Third Generation

Expected date of introduction:
— late in 1991: Eryx, short-range antitank missile;
— 1996: Aster, supersonic surface-to-air antimissile family (first naval version to equip the "Charles De Gaulle" aircraft carrier);
— 1998: ANS, supersonic antiship missile, to replace the Exocet;
— 2000: AC3G, long and intermediate-range antitank missile;
— after 2000: Aster-ATBM, ballistic antimissile missile, the European super-Patriot;
— unconfirmed date: Polypheme, optic-fiber guided missile.

[Box, p 18]

Space: From Helios to Hermes

Expected date of introduction:
— 1994: Helios, military observation satellite;
— 1995: Ariane 5, unmanned launcher, more powerful than Ariane 4, capable of launching either satellites or Hermes;
— 1998 (unmanned), 1999 (manned): Hermes, spacecraft;
— 2020: STS 2000, single-stage or twin-stage reusable freight-transport space system; designed to replace Hermes.

[Box, p 19]

Aircraft: Pending the Hypersonic Era

Expected date of introduction:
— 1992: Airbus 340, long-haul four-jet aircraft, 270 passengers;
— 1993: Airbus 330, medium-haul twin-jet aircraft, 330 passengers;
— 1994: Airbus 321, 200-seat twin-jet aircraft;
— 1996-1997: X92 and X122, twin-engine aircraft, 90-130 passengers;
— 2000: FLA, military transport aircraft; designed to replace the Transall;
— 2001: Airbus 350, 700-seat superjumbo aircraft; designed to replace the Boeing 747;
— 2005: ATSF (Alliance), 270-seat supersonic aircraft; designed to replace the Concorde;
— 2020: AGV, hypersonic high-speed aircraft (Mach 5).

[Box, p 19]

Helicopters: The Military First

Expected date of introduction:
— 1996: P120L, light civil helicopter, 4-5 seats;
— 1998-1999: Tiger, support, protection and antitank helicopter;
— 1998-2000: NH90, tactical transport helicopter, plus naval version;
— 2005: EL500, 5-ton twin-engine helicopter; designed to replace the Dauphin.

[Box, p 20]

Nuclear Power: A Political Asset

Expected date of introduction:
— Being negotiated: S4, strategic missile; designed to replace the S3 missiles of the Albion Plateau;
— 1992: Hades, prestrategic missile; designed to replace Pluton in the army;
— 1994: M45, strategic missile; midway between the M4 and M5;
— 2000: M5, strategic missile; to replace the current M4 on nuclear submarines.

France: SEP Creates Data Base for Ariane 5's Vulcain Engine

91WS0347B Paris INDUSTRIES ET TECHNIQUES in French 5 Apr 91 p 51

[Article by Alix Denolhac: "Vulcain Engine Tests: Data Processing Federates Testing"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] To resolve the problem of multi-site management of Vulcain engine test data, SEP [European Propellant Company] is centralizing all data.

In the development of an engine such as the Vulcain—the Ariane 5 engine—the testing and monitoring process occupies a very high place among the multitude of difficulties that have to be surmounted . In the case of the Vulcain program, which is managed by France's National Center for Space Studies [CNES], things are further complicated by the multiplicity of European participants: SEP as prime contractor, in France; MBB [Messerschmitt-Bolkow-Blohm] in Germany; and Fiat Aviazione in Italy. SEP has, therefore, set up Etna 5, an engine test data batch-processing system, and has centralized the results of all tests in a data base at Vernon.

Two test facilities are installed at Vernon: One for the engine's fuel supply system (hydrogen and oxygen turbopump coupled with the gas generator), and the other for the complete engine. These are in addition to the four installed at MBB and Fiat. Each of these facilities is equipped with an on-line data processing system [STI], enabling an initial validation of the data. But the data were being analyzed only after an extremely lengthy and complex process. "The data collected by each STI was being printed out, then sent 'as is' to the different departments concerned with analyzing them," says Bruno Cardon, who heads SEP's Instrumentation and Data Processing group. This resulted in lengthy read-out delays and in delayed correcting of the anomalies found. "The only way to resolve this problem," he says, "was to route all data to a centralized data base that could be interrogated by way of graphic displays installed at each site."

15 Workstations and a Vectorial Computer

The originality of the system rests on the importance it accords to graphics. During the initial phase, not less than 30 Sigmex terminals were installed at the different sites, all able to communicate directly with the Vernon center's Encore Powernode minicomputers (running UNIX), but also having sufficient local data processing power to provide an instantaneous graphic-mode display of the test data. Since September 1990, as a result of a further upgrading of the system, some 15 Silicon Graphics Personal Iris workstations and, in particular, an Alliant FX 80 vectorial computer, have been installed, retaining the Encore minis as data servers.

All of the tools needed for human-computer dialogue as well as the sophisticated graphics tools have been integrated with the programming of the workstations. Each user thus performs some elementary mathematical operations on the data stored in the base, such as self-checking and frequency spectrum computations, either by using existing applications or by developing his or her own analytical tools.

The stations in the Vernon test-facilities zone are linked to the data processing center 2 kilometers away by means of a Bridge server and an Ethernet LAN [local area network]. The remote sites are connected to the center by way of an Ethernet WAN [wide area network]. Today, "communication is no longer an obstacle; all the design engineers speak the same language."

[Box: The Etna 5 System]

SEP developed Etna 5 jointly with the CR2A data processing services and engineering company, but retained Cap Sesa's Italian subsidiary to develop the application software.

The Alliant FX 80 computer, with its 70.8 Mflops [million floating point operations per second], has three vectorial processors. The battery of four Encore Powernode minicomputers develops a power of 10 Mips [million instructions per second], in a redundancy configuration.

Two Ethernet networks have been installed to enable liaison among the different sites (including CNES at Evry)—one for Ariane 4, and the other for Ariane 5. The two are federated by way of an FDDI optic fiber.

Ariane 5's Vulcain Engine Test Lasts 200 Seconds

91WS0351A Paris AFP SCIENCES in French 2 May 91 p 8

[Text] Paris—Development of the Vulcain engine for the future Ariane 5 rocket continues at the European Propellant Company [SEP]. On 25 April, for the first time, the engine operated for 200 consecutive seconds during a bench test, at Vernon (Eure), it has been learned at SEP and at the National Space Studies Center [CNES]

Prior to 5 April, tests on this engine had never exceeded a duration of 20 seconds. On that date, the duration of the test was extended to 60 seconds, but the engineers experienced a minor problem with the long exhaust nozzle with which the engine would be equipped in normal operation in space. Among other things, this type of nozzle augments the thrust delivered by the engine in space.

Rather than await the results of analyses, in France and Germany, as to the causes of the problem, SEP and CNES preferred to continue testing the engine using a short nozzle, such as is normally used only for atmospheric tests at ground level.

The test this time around, on 25 April, lasted 200 seconds, which is a third of the time the engine will be expected to operate in space. "It operated to our full satisfaction, and the test is considered very representative of the engine's

operation above the exhaust nozzle," said an SEP spokesman. "The test schedule, which calls for a 600-second test before the end of this year, is holding, and it is possible that we may even steal a march on it."

Development of Ariane 5, powered by a cryogenic (hydrogen and oxygen) engine, has been under way since 1987, under the aegis of the European Space Agency [ESA]. This rocket will be able to launch two 2,950-kg satellites simultaneously, or a single 6.8-ton (metric) satellite, into geostationary transfer orbit. It will also be used to launch the Hermes space plane into low earth orbit (up to an altitude of 500 km) around the year 2000.

Germany: Space Agency Funding Reviewed

91MI0385 Duesseldorf HANDELSBLATT 16 May 91 p 8

[Text] The financing of German space activities is still uncertain. Even a new draft of the fifth space program, drawn up by the German Space Agency (DARA) at the request of the Federal Government, provides no answers. There is still a gap of almost 6 billion German marks [DM] between the draft, of which the HANDELSBLATT has a copy, and medium-term budgetary planning.

DARA estimates that it will require approximately DM25 billion for space missions until the end of the century. The space agency has thus come closer to the guidelines already laid down by the "space cabinet" in June last year. To date, DARA has always called for more than DM28 billion for space projects in its benchmark figures. Medium-term budgetary planning, however, provides for only a little more than DM19 billion, based on a projected annual increase of 2.5 percent.

Federal Research Minister Heinz Riesenhuber still seems less than entirely satisfied with the space agency results. In a letter to the Bundestag research committee, he has stated that both the arguments put forward in the draft and the figures will be further discussed "at working level" between the various departments and DARA. If Riesenhuber heeds DARA's recommendations, the space allocation in his overall budget will soon be approaching 30 percent.

According to DARA, savings against their benchmark figures will be achieved by curtailing, stretching, and dropping subprojects. The three particularly costly European Space Agency (ESA) projects (the Ariane launcher, the Hermes space shuttle, and the Columbus, Europe's contribution to the international space station, Freedom) will proceed with cutbacks. For these projects alone the Federal Government is committed to ESA for over DM19.3 billion. The ministers involved will decide on expenditure reductions in the fall.

The financial difficulties of the German space sector were at the center of yesterday's hearing organized by the Bundestag Committee on Research, Technology, and Technology Impact Assessment. The Confederation of German Industry (DBI) spoke in favor of separating space projects out of the research budget and listing them as a separate budgetary item.

Reiner Klett, a specialist from the medium-scale space company Kayser-Threde, warned against "apparent budgetary relief" that took the form of stretching projects. This would lead to increased costs, invisible only because they would be payable after the turn of the century.

Skeptical assessments come from Frieder Meyer-Krahmer of the Karlsruhe Fraunhofer Institute of Systems Engineering and Innovation Research. Information technology and microelectronics were fields of greater benefit than space to a national economy. The Bonn academic said that there were many experiments that would better be carried out on unmanned space missions.

Germany: DASA Plans Reorganization

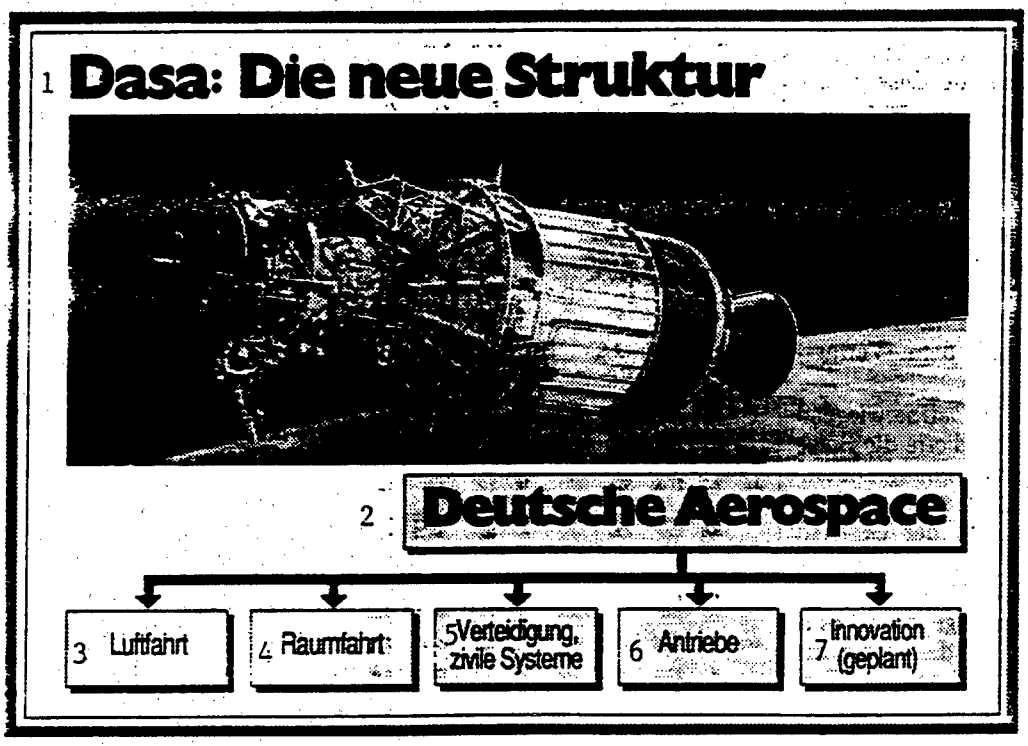
91MI0382 Bonn DIE WELT in German 24 May 91 p 15

[Text] Juergen E. Schrempp knows that he agrees with Federal Economics Minister Moellemann on one central point: "When calling for subsidy reductions, we have to make a fine distinction between state funds that keep certain branches of industry alive artificially and those that help companies overcome specific lean periods through reorganization." It is the latter form that the chairman of the board of German Aerospace AG (DASA) in Munich is calling for on behalf of his firm.

Founded on 19 May 1989 by Daimler-Benz as its aerospace and defense division, DASA depends heavily on the state budget: About 60 to 70 percent of the 12.5 billion German mark [DM] sales that DASA achieved in 1990 were generated by business with public contractors or supranational organizations (space). Of the R&D expenses incurred in the same period, which, at DM4.2 (3.8 in 1989) billion, are equivalent to about 33.6 percent of overall sales, developments of the company's own account for the relatively low figure of DM800 million.

DASA chief Schrempp has high hopes for the new organizational structure. In 18 months, a conglomerate comprising Messerschmitt-Boelkow-Blohm (MBB) GmbH, Dornier GmbH, MTU Motor and Turbine Union, and Telefunken Systems Engineering (TST) GmbH has been forged into an integrated aerospace corporation consisting of four divisions: aviation, space, defense and civil systems, and propulsion systems. The company plans to open up new markets in the civil field, thus systematically disengaging from the manufacture of defense equipment and reducing military products' current share of its overall sales from 48 to 25 percent. The new fields include traffic management technology and renewable energies, and there are also plans to group microelectronics activities together—indeed, an idea that would exceed the confines of the Daimler group is being considered: DASA wants to set up a joint venture with the Heilbrom-based AEG subsidiary Telefunken Elektronics GmbH to produce and market transistors, chips, and logistic components.

1. DASA's New Structure



Key: 2. German Aerospace—3. Aviation—4. Space—5. Defense, Civil systems—6. Propulsion system—7. Innovation (planned)

Schrempp believs that his strategic alliances have left him well equipped in DASA's four major fields of business. For example, DASA and its French partner Aerospatiale have combined their helicopter divisions to form the new Eurocopter company, which is now the world's second largest helicopter producer, after the American supplier Sikorsky. The Daimler subsidiary is also working with both the French and the Italian company Alenia on developing and producing a new regional aircraft to seat 80 to 130 passengers: A project that will bring the Munich firm success as system leader.

In spite of its supranational commitments, the company is not neglecting the new federal laender, Schrempp emphasizes. In addition to the recently agreed takeover of the LTL engine plant in Ludwigsfelde, the Hamburg-based German Airbus GmbH is also planning to set up a joint venture, Elbe Aircraft Works, in Dresden. Airbus and MBB contract packages have already been relocated there.

Exchange rate problems for the Airbus left DASA's annual accounts for 1990 deep in the red, with a DM135 (139) million loss. Without this "special effect", the corporate result would have been positive, declares DASA finance chief Bischoff: The industry estimates about DM200 million. While a repeat of the previous year's result is the aim for the current year, sales, which grew by 5 percent in 1990, are expected to rise by 3 percent this year.

Italian, European Agencies Face Space Debris Issue

91MI0412 Rome SPAZIO INFORMAZIONI in Italian 6 Jun 91 p 2-3

[Text] The problem of so-called "space debris"—be it nonfunctioning satellites, parts of launchers, old uninhabited orbiting stations, or etc.,—was the theme of a recent meeting organized in Rome by the ESA [European Space Agency] and the ASI [Italian Space Agency]. A number of Italian and European experts attended the meeting, including representatives from ESOC [European Space Operations Center] of Darmstadt (Germany), ESTEC [European Space Research and Technology Center) of Noordwijk (Netherlands), the Department of Civil Defense, the Universities of Rome and Pavia, the CNR's [National Research Council] CNUCE [National University Center of Electronic Calculation] of Pisa, Alenia Spazio, Officine Galileo, and Italspazio.

At the meeting, the representatives from the two ESA centers emphasized that obtaining funds for studies and projects in this sector is currently a major problem. In fact, three contracts for a total value of 850,000 European currency units [ECU] that should have begun this year are practically at a standstill. They include: "Columbus Viewport Materials," "Orbiting Space Debris Detector System," and "Impact of Space Debris on the Operations of Manned Spacecraft." In Italy, however, the ASI is

continuing its talks with the Department of Civil Defense on the establishment of a national service to monitor space objects during their reentry into the atmosphere, possibly using two "ad hoc" radar systems. According to reports, Alenia recently presented the Civil Defense authorities with a proposal to develop a radar derived from those used to control airspace while an additional survey is under way on the technology available in the United States, France, and Germany.

At the Rome meeting, the ASI also illustrated the so-called "Reentry Emergency Organization," the structure that could be activated in the event of an alarm caused by the reentry of dangerous space objects, as in the recent case of the USSR's Salyut-7 orbiting station. This structure provides that the Civil Defense authorities coordinate the actions of all relevant government agencies (ministries, armed forces, Italian Red Cross, ENEA [National Committee for Research and Development of Nuclear and Alternative Energies], ENEL [National Electric Power Company], the prefects' offices, USL [Local Health Offices], etc.), on the basis of the real-time data on the possible reentry trajectory provided by CNUCE with the financial and organizational support of the ASI.

Italy's Alenia Receives EC Funding for EUREKA Projects

91MI0329 Milan ITALIA OGGI in Italian
25 Apr 91 p 10

[Excerpt] The EC Commission approved Italian public funding to Alenia yesterday. This consists in discounts on interest on a 43 billion lire loan, and a grant of 30 billion lire allocated under Law No. 46/82 which established a special fund for technological innovation.

The funding is linked to Alenia's participation in eight EUREKA [European Research Coordination Agency] projects. The commission has also authorized a package of one-year measures for small- and medium-sized companies, which Italian government intends to present to parliament, for high technology investments.

The rate of public funding comes to 20 percent of total investments, except for the less favored areas, for a total commitment of approximately 1.5 trillion lire. [passage omitted]

Italy: Alenia Director on Research Activities

91MI0338 Rome AIR PRESS in Italian
24 Apr pp 881-883

[Text] "We Italians still fail to fully understand the importance that the EEC will acquire over the next few years: We must realize that it is about to become a real supranational government." The statement was made by Alenia's president, Fausto Cereti, at the Brussels "Aeronautics Days 1991," a two-day meeting organized by the EC commission to examine the status of BRITE/EURAM [Basic Research in Industrial Technologies for Europe/European Research on Advanced Materials] program (1987-1991) which has an allotment of 60 million European currency units [ECU] in funding for the aerospace sector. At the opening of the plenary session of the two-day conference (16 and 17 April), Cereti took the floor as chairman of the AECMA (European Association of Aerospace Equipment Manufacturers). In a subsequent meeting with the Italian press, however, he dealt with the issues of direct interest to the Italian aeronautics industries within the framework of the European Community, and their relationships with EC industries and the rest of the world, particularly the United States. Talking about the need for a European approach in current and future initiatives in the aerospace industry, which is going through a period of great uncertainty due to the recent and unexpectedly rapid worldwide changes, Cereti stated: "Italy still has a long way to go."

The need to deliniate a new "defense model" at the national and international level is one of the areas of major interest to the aerospace industry. Cereti stated: "I admit that the cuts in the Italian defense budget are a source of great concern, in particular because these cuts were not foreseen." For example, if the defense budget is cut by 5 percent, modernization expenditure is subsequently reduced by 50 percent. Furthermore, if government expenditure under the same entry remains unchanged, overheads increase. Hence, out of a 25 trillion lire annual budget, only 4 trillion lire can be spent on modernization (that is, the purchase of new equipment and, above all, research activities).

Cereti asserted; "The Ministry of Defense was (and still is, to a large extent; the ongoing EFA [European Fighter Aircraft] program is an example) known to be the main driving force for aeronautics research. Alenia's research expenditure accounts for 22-23 percent of its turnover, and approximately 90 percent goes to the militay sector." The overall amount is about 1 trillion lire per year, half of which is for the EFA. According to Cereti, the current situation of "great uncertainty" will lead to a slowdown in the budget that "will last for at least four to five years." In this time frame, while a new "global defense model" is being studied (according to Cereti: "I believe that future defense systems will rely primarily on space technology"), activities should focus on ongoing programs and/or the civil sector. Cereti observed: "Programs like the EFA or the EUROSAM missile project will allow our company to keep its workforce of engineers and researchers. Should they be obliged to leave, this would have serious consequences on the company's future."

In Italy, the political definition of the "new defense model" (as indicated by parliament) should necessarily be accompanied by a "practical model" that can turn general principles into concrete options. "The Gulf war," stated Cereti, "demonstrated that one of the basic theories is that intelligent weapons and robotics are to be used whenever possible to save the most human lives in case of conflict." Hence the possibility of using remotely piloted vehicles or, more generically, "war robots" that will be manned in times of peace and remotely piloted when war breaks out.

The new world order and the financial situation have upset all new military aircraft programs, including those Alenia is (or was) considering.

The Tornado, for example, was to be further developed, (and proposals had been made in that connection), but the whole matter has been shelved together with the design of its successor. The Tornado will be used for 35 years, and it will be difficult to increase the number of aircraft the Italian Air Force will have at its disposal. At the most, the current number (100) may be increased to 120. Alenia's current orders in this area will keep it working, albeit at a much slower rate, for a couple of years. Part of its production capacity was redirected to the AMX, a defined program that will require three to four years (depending on when the order for the third batch of 50 aircraft is received) to complete.

As far as the G.222, the twin turbojet tactical transport aircraft, is concerned, the United States has placed an order for 10 units and an option for another eight, while Korea, the Gulf states, and others are currently considering the matter. Cereti remarked: "We will wait and see. We believe that transport aircraft are in a better position than fighters. This is because a large number of countries have been using old transport aircraft and, since they are neither interested in nor in need of fighters at this time, they can spend part of their resources in this area." According to Alenia's president, the current production rate of seven G.222 units per year "could increase slightly."

The European Research Situation

The above remarks must be seen in a wider context, particularly in reference to European research activities in this area. According to Cereti: "There appears to be a certain degree of consensus among European industries as to the need for joint research projects. Disagreement, if at all, emerges in the relationship between the EC Commission and the individual governments as to how investments should be managed and who should be responsible." Countries such as Greece which are not ready to provide funding for research which cannot guarantee immediate results in view of the state of their manufacturing sector, are stimulated by the "fair returns" concept. The countries most eager to see a greater EC commitment in this field include France (for obvious reasons), while, at another level, social market economy concepts (in Germany) are pitted against liberalist ideas (UK).

Competition among industries is another factor to be considered. The concept of total or partial EC funding for pre-competitive research is taking a foothold in this area. This means that EC funding will be granted to programs whose results can be shared without frustrating individual companies' entrepreneurship. The borderline between pure research, the findings of which are readily available to all, and the applications stage, will be difficult to establish.

Tension exists between the EEC and the United States on this issue and on the subsidies given to various research activities or companies. The United States, in particular, brought the German Airbus partner before the GATT Commission on the grounds that it was subsidized by its government and therefore sold its aircraft at dumping prices. The United States also claims that much of the findings of its research activities are shared at world level because, for example, they are reported in the press.

"I believe that Airbus and the United States will eventually come to an agreement," Cereti stated, "and avoid sparking off another trade war. For the time being, nobody has come up with feasible solutions because of the conflicting interests at stake in sectors such as aeronautics, agriculture, and textiles. We will wait and see what happens."

Such remarks led to the examination of why Alenia acquired the De Havilland Canada company. Cereti said: "In this way, we may enter the American market through a company that is already there." Furthermore, with this acquisition Alenia adds a further 20 percent to its 20-25 percent share of the commuter aircraft market that "will provide us with the essential critical mass for successful operations." Talking about acquisitions, Cereti stated that Alenia "does not plan to expand any further." It is, rather, working at streamlining its existing resources. Accordingly, Partenavia's activities are expected to be gradually transferred to Piaggio, while, in the engines sector, synergies will be pursued between Alfa Romeo Avio and Piaggio without affecting the Finale Ligure and Naples plants.

Cereti concluded by reasserting the need for an industrial policy at the European level to avoid the risk of having only three or four large production segments such as in the United States. For example, the railways in the United States are now used for freight transport only as a direct consequence of the lack of funding. Alenia's president remarked: "In the long run, this policy is counterproductive." In the aeronautics sector, Cereti expressed the hope that some R&D subsidies (about 45 percent) be maintained for the time being but subsequently phased out as the program proceeds. For small aircraft (but the question here arises as to whether the adjective "small" should be used for 70-, 100-, or 200-seater aircraft), subsidies could be eliminated. However, in this case, a whole series of details need to be defined both at EEC level and within the framework of global relationships among individual companies.

Italy's Alenia Pursues Ecological Satellite Project

91MI0364 Rome AIR PRESS in Italian 1 May p 935

[Text] Alenia Spazio is currently working on an "ecological" satellite with a 20-meter resolution to study and safeguard the environment and the effects of human activity in the European-Mediterranean area down to equatorial Africa. The satellite is called Ecosat and a preliminary mission has already been scheduled based on requests received from ASI (Italian Space Agency) and the Ministries of Civil Defense, the Environment, and Agriculture. Ecosat is scheduled for launching in early 1996 and may also be used to study the interaction of man with the environment and in particular water (water reserves, natural disasters, pollution), earth resources (vegetation, minerals), uninhabited areas, and the marine environment (biology, fishing, microclimatology, pollution, coastal erosion). Ecosat will make these observations from its 600 km polar orbit by using two instruments primarily: an X-band

radar, and a multispectral sensor working in the near infrared and visible light spectra.

By combining these various physical surveying "windows," data can be obtained both day and night, and under cloudy weather conditions. The radar sensor is sensitive to the morphological features of the surface, while the multispectrum is sensitive to its chemical and physical aspects. The radar sensor can cover 80-km strips of territory, with a high resolution (20mx20m), or 240-500 km areas at a low resolution (40mx60m). The other sensor can work on a 240-km wideband, with a 20-meter physical resolution, and three spectrum bands (red, green, and blue), or on a narrower spectrum (80km) with 19 spectrum bands (15 visible and 4 infrared), and a 20m to 40m resolution. It can even work in "stereo," and provide a three-dimensional reconstruction of the area observed to obtain topographical reconstructions and an improved calibration of high resolution images.

Alenia Spazio emphasizes that the Ecosat program will combine the technologies already used in other Italian programs in which Alenia Spazio is the project leader. Its structure may originate from the Italian SAX [X-Ray Astronomy Satellite], which is designed for the study of X-ray sources in space, while its radar sensor may be developed using the technology adopted for the X-ray Earth observation radar to be carried on the space shuttle. The ground control network and data collection would be carried out by the existing Italian installations in Matera and Fucino.

Italy Hosts Conference on Earth Observation Satellites

91MI0334 Rome SPAZIO INFORMAZIONI in Italian 24 Apr 91 pp 2-4

[Text] Sophisticated remote sensing space technologies are being used increasingly to solve environmental problems and also account for an interesting market niche. This is probably the reason why all the major Italian and European companies presented their environmental monitoring projects at the recent international symposium in Venice on "The Earth's Environment, An Assessment from Space." On the one hand, therefore, experts and scientists are busy trying to understand the mysterious mechanisms of nature and the weather and to identify the changes brought about by man's presence, and on the other, specialized companies are ready to demonstrate the ability of sensors, satellites, and orbiting platforms to collect large amounts of data on the state of our planet.

The primary goal of the Venice symposium—which was held at the Fondazione Cini by the European Association for International Space Year (EURISY)—was therefore to create a forum where "science" and "technology" could meet and exchange views in order to face environmental problems in an informed manner and with highly sophisticated tools. Remote sensing via satellite can already play a very important role in this area since it has become the object of a large number of initiatives in Europe. The ESA (European Space Agency), for example, after successfully extending the range of Meteostat meteorological satellites, is now working on new projects that were presented in Venice by Professor Philip Goldsmith, director of the ESA's Earth Observation Program. The ERS-1 (European Remote Sensing Satellite) for ocean studies will be launched into orbit early in May and will be followed in 1994 by the ERS-2, equipped with special equipment to assess the amount of ozone in the atmosphere. In 1997, ARISTOTELES (Applications and Research Involving Space Techniques for the Observation of the Earth's Field from the Low-Earth-Orbit Spacecraft) is scheduled to be launched for the observation of the Earth's gravitational and magnetic fields, while in 1997-98 the POEM-1 (Polar Orbit Earth Observation Mission) will be placed on the Columbus Polar Platform for meteorological, climate, and ocean studies. In his speech, Prof. Goldsmith stated: "The ESA intends to provide the data that is required to understand environmental problems and related phenomena and to enable governments to decide which measures to adopt." In addition to the ESA, other European countries such as France with Globsat and Germany with Atmos, are currently working at projects on new earth observation satellites for environmental remote sensing.

Italy's Ecosat Satellite

Italy, too, is becoming active in this sector. The EURISY symposium provided Alenia Spazio with an opportunity to present its Ecosat project for the first time. The project involves constructing a satellite to study and protect the environment, and to identify and assess the environmental impact of human activities mainly in the Mediterranean basin, northern Europe, and around the Equator. Professor Ernesto Vallerani, Alenia Spazio president, stated in Venice: "Ecosat is a preliminary attempt to combine consolidated corporate expertise to develop a satellite that will observe certain phenomena and allow experts to understand environmental changes." This satellite, deriving from the technlogical know-how acquired by the former Aeritalia company, should be carried into orbit in early 1996 by an Ariane-4 launcher. It will be equipped with two sensors: an X-SAR (synthetic aperture radar), and a MIOS (multispectral imaging optical sensor) that operates in the visible and infrared light spectra. With an estimated overall weight of 1,670 kg (780 kg of which are the payload), Ecostat could be built using a modified "body" of the SAX (X-Ray Astronomy Satellite) Italian-Netherlands scientific satellite, and operate at a height of 600 km in a polar, heliosychronous orbit. Prof. Vallerani pointed out: "Ecosat was conceived to complement its French and German counterparts and, therefore, its configuration is not definitive." Prof. Luciano Guerriero, president of the ASI (Italian Space Agency) added: "We have already suggested coordinating these three initiatives to make them complementary and provide a complete picture for the future European polar platform." ASI is currently exploring the possibility of continuing a bilateral study with France's CNES (National Center for Space Studies) for the development of a new infrared interferometer (called IASI), whose preliminary configuration has already been defined by the Officine Galileo. Similarly, 60

billion lire in funding have been confirmed for the 1990-94 National Space Plan update—which, however, has not yet been officially submitted to the CIPE [Interministerial Committee for Economic Planning]—earmarked for a small earth observation satellite. An upgraded Scout launcher should launch this mini-satellite from the San Marco launch site in Kenya in the next few years.

Giuseppe Grande, Fiat Spazio president, illustrated this project in Venice. Two models have been defined: Scout 2, with two BPD solid propellant boosters, capable of launching, at a height of 550 km, a 500 kg payload into an equatorial orbit and a 350 kg payload into a polar orbit, and Scout 4, with four boosters, capable of launching an 800 kg payload into an equatorial orbit and 600 kg payload into a polar orbit. In his speech, Grande stated: "Fiat Spazio has combined several Fiat group companies and has reached a series of agreements with national and international companies. We are, therefore, now in a position to offer clients a complete service that includes: mission analysis, system study, design, development, satellite acquisition and integration, launch, orbit control and data collection services." However, when asked by SPAZIO INFORMAZIONI about the development stage of the new launcher (also called San Marco Scout by the ASI), Grande revealed that: "We are still waiting for ASI's response to a proposal for the second study stage which we submitted quite a while ago. No renewal contract has yet been signed."

The Spot Environmental Satellite

Italy, too, seems to be developing a greater awareness of the importance of space remote sensing techniques in environmental monitoring. During the EURISY symposium, Telespazio, an IRI-STET [Institute for the Reconstruction of Industry - Turin Telephone Finance Company] group company announced it had secured a contract from the Ministry of the Environment for the use of images taken by the French Spot satellite. The managing director of Telespazio, Raffaele Miniucci maintained: "A method that uses Spot's panchromatic data has been developed to classify 8,000 km of national coastline into different categories using the main indicators for pollutants discharged into the sea. Spot images were used to obtain an updated description of land coverage and use with special reference to urban, industrial, and agricultural areas and ports, which are the main sources of pollution along the coasts.

Italy: ESA Center for Remote Sensing Satellite Data Opened

91MI0335 Rome SPAZIO INFORMAZIONI in Italian 24 Apr 91 pp 4-6

[Text] At the recent inauguration of the EECF (Earthnet ERS [Environmental Remote Sensing Satellite] Central Facilities) at ESRIN [European Space Research Institute] in Frascati (Rome), Dr. Jean-Marie Luton, ESA (European Space Agency) director general stated: "ESRIN will guide and lead European earth observation strategies over the next 20-30 years." Many experts in the field were present at the ceremony including Senator Learco Saporito, under secretary of universities and scientific research; ESRIN director, Francis Roscian; ESA council president, Professor Francesco Carassa; ASI (Italian Space Agency) president and director general, Professors Luciano Guerriero and Carlo Buongiorno; the director of the San Marco project, Professor Luigi Broglio; head of the Space Division of the Ministry of Universities, Engineer Francesco Mazzuca; ASI scientific committee president, Professor Remo Ruffini, and Alenia Spazio president and managing director, Professor Ernesto Vallerani and Dr. Andrea Pucci.

EECF Activities

The EECF is expected to ensure the best and most comprehensive use of data collected by the new ERS-1 [European Remote Sensing Satellite] (to be launched by an Ariane-4 launcher from the Kourou launch site in French Guyana between 3 and 4 May), to meet the diversified needs of users. ESRIN has developed sophisticated computer equipment to ensure uninterrupted connections both with ESOC (European Space Operations Center) in Darmstadt, Germany, which programs the operations of the missions prepared by the EECF, with the earth stations to program the quasi-real-time distribution of the data, with the EDP centers for the output ordered by users, and with the users themselves to give them direct access to the catalogue of worldwide ERS-1 data and message exchanges.

Speeches by Saporito and Luton

In his speech, under secretary Saporito stated: "The most important aspect here is probably Italy's determination to make this ESRIN center, which is the ESA's point of contact with users and the epicenter for the future of our environment, play the role it deserves. This cannot but encourage the Italian government to take on international commitments at the ESA's next ministerial conference. Italy intends to honor its commitments in this direction so that the logistic infrastructures and the necessary additional space can be made available to ESRIN as soon as possibe." In the subsequent press conference Senator Saporito pointed out that an ad hoc commission has been set up "to improve ESRIN's development prospects" and that, following a study carried out by the ASI to resolve the center's logistic problems, the Ministry of Universities is about to officially assign the task to the ASI "with the possible advancemnt of funds."

Luton in turn said: "We can already affirm that ESRIN's future in the years to come will be closely related to social and political activities. We will follow this development with great expectations. We will use all the support that the Italian authorities can provide to achieve our goals at ESRIN. In fact, constraints are already being felt in terms or infrastructures and space for personnel."

The ESA's Problems

The presence of Dr. Luton at the press conference with Senator Saporito provided an opportunity to deal with the

organizational and financial problems that could become an obstacle to future activities. Senator Saporito stated: "We are concerned because European countries are going through difficult economic times. Therefore, two ministerial meetings will probably have to be called to assess the current situation and identify future objectives. We are dubious and dissatisfied because the Italian effort has not provided sufficient spin-offs to justify our expenditures to parliament." When asked by SPAZIO INFORMAZIONI to comment on these statements and provide some information on the proposal to update the ESA's long-term plan, Luton replied: "Italy's returns in terms of financial and human resources correspond to its investment. The effects, however, will only be felt after a few years. Only in the last five years did Italy increase its financial contribution and therefore the returns are not entirely satisfactory as yet. This will come slowly because trends cannot be reversed in a few months or years. There are sectors in which there is room for improvement, but please do not ask me to return in two months and show them to you."

Dr. Luton then went on to address the issue of updating the long-term plan, which should be approved at the ESA's next ministerial conference scheduled for next fall (October?) in Germany perhaps. He emphasized that he was aware that, "financial problems do exist and all the decisions taken at the Hague conference in 1987 cannot be implemented. At a recent informal meeting held in Santa Margherita Ligure, the board proposed revising the plan with a 10 percent reduction in funding between 1987 and the year 2000 that will still allow us to honor earlier commitments. I am reasonably confident," he concluded, "that our general goals can be achieved."

Italy: Space Contracts Awarded

Propulsion Systems

91MI0328A Rome SPAZIO INFORMAZIONI in Italian 2 May 91 pp 2-3

[Text] BPD's space division (Fiat group) has recently been assigned two contracts for the propulsion systems of the Italian Italsat-F2 telecommunications satellite and the Italian-Netherlands SAX (X-Ray Astronomy Satellite). These two contracts, worth approximately 20 billion lire, were signed with Alenia Spazio (IRI-Finmeccanica [Institute for the Reconstruction of Industry-Mechanical Engineering Finance Corporation] group), which is in charge of these two projects for the ASI (Italian Space Agency).

BPD will supply the UPS propulsion system for Italsat-F2. Development of this system began last March and will conclude in March 1993 when the flight unit is delivered to Alenia Spazio. UPS comprises an apogee motor (with a 490 N thrust) for the geostationary orbit of the Earth after launch, and 16 engines for attitude control (22 N, divided into two, eight-engine sections) to ensure a correct orbiting position and antenna direction. The propellant (monomethylhydrazine and nitrogen tetroxide) will be contained in two 400-liter pressurized helium tanks. UPS was also used on the Italsat-F1 satellite. It is the first Italian bipropellant propulsion system and was completely developed by BPD.

The project involves developing three models of the system: 1) a mock-up to test the configuration and integration sequence; 2) a structural model for mechanical and structural tests; and 3) a model to check operations, using a standard flight component configuration. The German MBB-ERNO/DASA [Messerschmitt-Boelkow-Blohm-Northern Development Area/German Aerospace Agency] will develop the fuel tanks for the UPS, the German company MAN will develop the four helium tanks, the American company Carleton will develop the double stage pressure regulator, and Fiat-CIEL (Gilardini) will develop the equipment for helium and propellant supply.

BPD will develop the RCS [radar cross section] propulsion system for the SAX satellite. Development began in May 1989 and will end with the delivery of the flight unit to Alenia Spazio in September 1992. The RCS will have 12 single propellant engines (10 N, divided into two, six-engine sections) to control attitude and maintain orbit. The propellant (hydrazine) will weigh 25 kg and will be kept in a 44-liter, pressurized helium tank. The program also involves the development of a thermal-structural model for mechanical and structural tests on the system. The American company PS1 will participate in the design of the RCS's spherical propellant tank, and the German MBB-ERNO/DASA will take part in the engine development.

Data Systems

91MI0328B Rome SPAZIO INFORMAZIONI in Italian 2 May 91 p 3

[Text] Cap Gemini Sesa Italia has recently signed contracts for ESA (European Space Agency) projects. It has been assigned an order by the CNES (National Center for Space Studies) for the development of the Teta system for a total value of 2.5 billion lire. This system will collect data transmitted by the European Ariane-5 launcher through tracking stations, and check the mechanical stress and load parameters. Teta will be delivered to CNES by 1992. Cap Gemini Sesa Italia has also signed a contract with the French company SEP [European Propulsion Company] for the SEA system which receives and processes data from Teta. Finally, the company is building a X-400 central server for the ESA's ESRIN [European Space Research Institute] center. This sophisticated control switchboard sorts messages via computer, and is slated for delivery in early 1992. Cap Gemini Sesa Italia is also planning to dedicate itself to ASI projects in the near future.

Robotized Probe

91MI0328C Rome SPAZIO INFORMAZIONI in Italian 2 May 91 pp 4-5

[Text] The Bologna-based company Riva Calzoni has recently received a contract from the ESA for the future Ariane-5 European launcher. The company will supply a robotized probe that uses a three-dimensional chamber to measure the solid propellant composition of the launcher's two large boosters (to be produced by the European

Europropulsion consortium) to ensure compliance with launching standards in all conditions. In addition, Riva Calzoni is currently studying a sophisticated nonvibrating system for use on Columbus's pressurized modules and the Italian-American San Marco Scout carrier.

MBB Develops Electromagnetic Interference Susceptibility Testing System

91P60237 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 10 Jul 91 p 8

[Text] Using a measuring device, Messerschmitt-Boelkow-Blohm GmbH (MBB) in Ottobrunn hopes to test the sensitivity of aircraft to interference from electromagnetic shortwave fields. According to a report in the company's in-house publication, NEW TECH NEWS (Jan 91), this entails the West's sole installation from which international aviation will profit as well.

While, up until a few years ago, aircraft were only mechanically controlled; today, electrical signals must first be directed to computers and from there to the electrohydraulic servo components of the control surfaces. Rod assemblies and cable controls linked to the joystick have been replaced by electrical leads (fly-by-wire system). And, even though these leads are laid out in quadruply-redundant configuration for reasons of safety, electromagnetic fields which simultaneously affect all systems can cause the electronics to react erroneously.

At the facility for measuring electromagnetic compatibility, environmental radiation states are reproduced under nearly the best possible conditions and in a manner that can be controlled and monitored. Using a shortwave generator which is connected to a 100 kW linear amplifier, nearly all existing signal shapes, in the 5-30 MHz frequency range, can be simulated. All essential types of flight operations would be faithfully simulated.

In serial tests, the measurements also yield information about highfrequency sensitivity to interference as a function of the age of an aircraft, since corrosion could precipitate cases wherein aircraft are still structurally sound while shielding against fields of electromagnetic interference is no longer guaranteed.

The measurement facility operates on two levels. On the ground-level platform, where an aircraft is subjected to vertically polarized fields, aircraft with wingspans up to about 35 m and lengths to around 40 m can be tested. On a 20 m-high testbed employing horizontally polarized radiation, test specimens with wingspans up to 15 m and a maximum weight of 30 tonnes can be studied. In building the device's control tower, iron and steel were almost totally dispensed with. The hoisting cables are made of Kevlar and the supports are made of glued plywood.

Germany: Saenger Development Prospects Discussed

91MI0319 Duesseldorf HANDELSBLATT in German 17 Apr 91 p 20

[Text] The German aerospace industry and a number of institutes will be working on the development of space engineering well beyond the year 2000: The Saenger recoverable space transporter, designed to travel at five or six times the speed of sound, could take on major project status.

Current information as to its feasibility was discussed at a meeting of experts at the Research Ministry in Bonn on Tuesday. Despite the difficult budgetary situation, Minister Heinz Riesenhuber (Christian Democratic Union) argued in favor of continuing the project. Horst Hertrich, head of the ministerial department concerned, told journalists that the project was in no way directed against the Hermes space shuttle, which is supported by the French. Saenger would rather belong to the subsequent generation of spacecraft.

Juergen Ruettgers, deputy chairman of the Christian Democratic/Christian Social Union alliance was very skeptical about the project's feasibility. Ruettgers, who is also spokesman for the Aviation Union, stressed that there was no guarantee that hypersonic research and the main Saenger project would survive beyond the first phase and that spending would not be automatically increased without review. He estimated development costs at about 48 billion German marks [DM], although if it were to take the form of a European project with German system control it would cost approximately DM19 billion. Ruettgers also said that the environmental pollution that it would cause should not be underestimated. In his opinion, it was unrealistic to assume that Saenger would be able to take off from Cologne/Bonn airport as a hypersonic aircraft.

Bonn will provide DM225 million of the overall DM340 million budget for the first stage of the work, which is scheduled for completion in 1992 and will cover design engineering and basic technology developments. No decision has yet been taken on whether to extend this phase by two or three years.

The Thatcher government in Great Britain vetoed state participation in the Hotol [Horizontal take off and landing] single-stage space transport project. Riesenhuber hopes that Saenger wiil attract cooperation within the European Space Agency, ESA. Cooperation is already under way with Norway and Sweden, and soon with Italy as well.

The basic principle for the space transporter came from the German space pioneer Eugen Saenger back in the thirties. Given the present state of technology, Saenger is conceived as a two-stage transport system using airports for take-off and landing. The lower stage is designed to reach seven times the speed of sound with hydrogen as fuel, while the upper stage is the actual space shuttle for use in manned missions or for cargo transport. After completing its mission in space, the Saenger would land on earth.

AUTOMOTIVE INDUSTRY

Japanese Auto Industry Sees 'Future Potential' in Electric Autos

91WS0378A Duesseldorf VDI NACHRICHTEN in German 3 May 91 p 10

[Article by Barbara Odrich: "Electric Car Within Reach—Battery Still an Unsolved Problem"]

[Text] Growing concern for the environment is forcing the Japanese automobile industry to rethink its priorities. At present, companies in Japan are in a tough race for the development of electrically powered cars, and they are making remarkable progress. The world's largest automobile exporter sees a promising future for electric cars.

There are still many unresolved questions when it comes to the development of electric cars for everyday use. The key question of whether these vehicles significantly reduce carbon dioxide emission remains unsolved. Another crucial problem is the battery. Recent progress in the development of batteries with a significantly higher capacity and extremely short charging time as well as progress in the development of composite materials have made the electric car a potentially viable solution. Still, the electric car carries a high price tag (it is three times more expensive than conventional cars), and the battery model developed so far must be replaced every two years and is extremely expensive.

Tokyo Electric Power Co. plans to present an electric sports car at the Tokyo Motor Show this fall. The car has been under development for three years. Moreover, Japan's leading automobile manufacturers have teamed up with the electric power companies to develop new electric cars. Toyota Motor Co., for instance, is cooperating with Chubu Electric Power Co. The automobile in question reportedly has an extremely light aluminum body. According to reports, Toyota plans to introduce an electric version of the popular Town-Ace model by the end of this year. Daihatsu Motor Co. is cooperating with Kansai Electric Power Co., and Nissan Motor Co. is working together with Kyushu Power Electric Co.

In addition, there are the newcomers. In May of last year, Nippon Steel Corp. presented a test model called "NAV", an acronym for Next Generation Advanced Electric Vehicle. The "NAV" design uses high-quality carbon fibers resulting in a considerable weight reduction. And finally, Honda plans to produce an electric motorcycle.

The Japanese power companies hope to use the development of electric cars to learn more about power storage technologies. In addition, it is expected that the advantages of nuclear power will become more apparent as the use of electric cars increases. Some think that the dependence on oil and coal is clearly undermining the efforts aimed at developing emission-free vehicles.

At present, numerous new electric car projects are attracting attention in Japan. Isuzu Motors Ltd. and Co-op Electric Vehicle Development Co, a division of the Japanese Co-op Organization, recently developed the prototype for an electric truck with a 2 t load capacity. According to the company, the performance of the vehicle is equivalent to that of a gasoline-powered truck. However, with a current price tag of 25 million Japanese yen the vehicle is still far too expensive. The new truck is powered by a battery with a six hour output capacity and a range of approximately 100 km. The maximum vehicle speed is 110 km/h.

According to the Japanese Electric Vehicle Association, 850 electric cars are presently in operation in Japan. It is expected that thousands of these clean vehicles will be in operation by the end of this decade. By the year 2000, the Co-op organization wants to replace 3,000 gasoline-powered delivery trucks with the new electric cars. At present, the Co-op vehicle fleet consists of more than 12,000 delivery trucks.

According to the Isuzu vehicle development center, mass production will make the innovative electric vehicle considerably less expensive so that it might even sell for as little as 6 to 7 million yen. The environmental agency in Tokyo is also interested in the new vehicle. It has already appropriated funds in the 1991/92 budget for the purchase of these vehicles by local authorities.

A new law passed in California provides an added incentive for pushing ahead with the development of the electric car. The new law mandates that by 1998 two percent of all new vehicles sold must be electrically powered.

Italian Firm Reports Cuban, Ferrocene Improve Engine Performance

91P60238 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Jul 91 p 8

[Text] Via the addition of Cuban, a cubic hydrocarbon, the effective output power of commercially available gasoline can be increased by around 5 percent. Cuban is a solid which is stable up to 200 degrees Celsius. The research group of an Italian automaker observed that a 447 cubic centimeter single-cylinder engine with direct fuel injection, whose fuel mixture was replaced with Cuban up to 30 percent by weight, managed to develop 17 kW of power at 5400 rpm instead of the usual 16 kW figure.

For the automotive firm, what appeared to be particularly interesting about the test model was that a vehicle powered by a gasoline-Cuban mixture not only performs better but has to make fewer fuel stops, owing to Cuban's higher density of 1.29 kilograms per liter. For quite some time, Cuban has been produced only on a laboratory scale. However, the researchers estimate that it would be worthwhile to build a larger facility for the synthesis of Cuban. But, another fuel additive could become interesting as well. By adding minute amounts (0.0015 percent) of ferrocene—an iron sandwich complex-to the fuel, the nitrogen oxide discharge in the exhaust can be reduced by up to 40 percent. Also, the proportion of carbon monoxide and hydrocarbons in the exhaust was smaller in the test vehicle using the ferrocene additive than in a comparison vehicle.

Even the fuel consumption of the midsized car used as the test vehicle was lower. Both this latter and a comparison vehicle with a standard catalytic converter covered a stretch of 80,000 kilometers. In diesel engines, owing to improved combustion, the ferrocene even reduced the discharge of soot. According to a report appearing in GIT (June 91), the laboratory's professional journal, the ferrocene additive also works favorably in older engine models whose fuels still rely upon the presence of lead alkyls. Just like the lead compounds, ferrocene protects the exhaust valve seats. This improves compression, prolongs the lifetime of the valve seats and has a positive effect upon engine performance. As the initial long-term tests with ferrocene indicate, this iron compound appears to be a technically more favorable expedient for reducing the pollutant content of automobile exhaust.

Germany: Fuzzy-Logic-Controlled Vehicle Presented

91AN0412 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 25 Apr 91 p 28

[Article signed E.F.: "Fuzzy Logic Takes Over From Driver"]

[Text] A research project for the application of fuzzy logic has recently culminated in the development of a prototype of a miniaturized car that weighs 3.5 kg and is operated by such logic. The project entailed studying the application of fuzzy logic to complex cases of vehicle dynamics control. For example, after abruptly braking a car moving at 50 km/h, it goes into an uncontrolled skid. It is up to the dynamics control system to restabilize the vehicle by conventional means (regain steering control, slight acceleration, or slight braking).

The project is led by the German university of Aachen in Rhineland-Westphalia, in cooperation with Parsytec, a German manufacturer of transputer-based parallel computers. Such computers can very well handle fuzzy logic applications because of their high level of parallelism, especially in applications requiring very high processing speeds. The prototype car shown in Hannover was equipped with an on-board, 40-Mips, 6-Mflops computer containing four transputers. The car had a 1-kW engine and a top speed of 80 km/h, thereby permitting a fairly realistic study of its handling. It was fitted with an ultrasonic sensor system allowing it to define its position relative to obstacles. A 286-microprocessor computer controls the sensors, the steering and braking servos as well as the engine.

Matra Introduces Automation, Robotics, to Renault Plant

91WS0332A Paris INDUSTRIES ET TECHNIQUES in French 19 Apr 91 pp 45-47

[Article by Michel Alberganti: "Robots At the Service of Quality"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] To solidify the new Renault Espace's position at the top of the line, Matra Automobiles is going all out on quality. This is the main motivation behind the advent of robotics and automation at the Romorantin plant.

A new model calls for new production tooling. The second version of the Renault Espace marks a change of orbit. Sustained by a success that continues to grow (1990 sales up 20 percent), production of Matra Automobiles' revolutionary car, brought out in 1984, will now shift from a quasi handicraft level to a production-line operation. The days of a 45-cars-a-day output are dead and gone. The Romorantin plants will be on a 250-cars-a-day schedule as of May of this year, to be upped to 280 cars a day in due time.

This rise in output entails no design compromise whatever. On the contrary: The rounded shapes of the 1991 model have done away with the "station wagon" look that some objected to in the initial version. The modular features of its interior appointments (swiveling and easy positioning of seats) are retained, and, in particular, its finely detailed interior trimmings and the finish of its "single-compartment" body will better justify its high price.

Romorantin's rise in production is coupled with the advent of its robots.

Up to 550 Units, Plastics More Economical Than Metal

Romorantin's robotization is almost entirely justified by considerations of quality. Flexibility, in this case, has not been a significant factor, especially since, despite the existence of several versions, Matra builds one and only one model on its production lines. All the technological choices are targeted on one objective: A reduction in manufacturing defects, with the bull's-eye being the total elimination of such faults in workmanship as compel the client to return to the dealer for "retouchings," with all that this entails for the manufacturer's image.

These quality shortcomings had practically disappeared, however, in the last cars of the old version. Christian Francois, who heads Procedures at "Romo 3," explains how Matra measures quality: "The rating system was developed by Renault. A perfect car is credited with 162 points. At the start of production of the Espace, we were running at a level under 100 points. By the end of production of the old model, we had raised this level to 145 points." This gain of approximately 50 percent was achieved without any change in work methods; that is, retaining a fully-manual method of assembly.

Today, the new production line has not yet exceeded the 145-point level. As Christian Francois sees it, however, this result is excellent. "We have succeeded in obtaining Renault's authorization to market by the dates planned," he points out. Thus, the new Espace starts out at the highest quality level attained by the old model. But it is slated to better that level. "Our objective is 151 points. At that level, only truly minor faults remain, such as do not give rise to complaints by its buyers." The post-sale "retouchings" will have been eliminated. Incidentally, this does not mean that they will have disappeared within the

Romorantin plant. Matra still employs a sizable roster of personnel assigned to this task. But, taking a cue from the Japanese plants, it is the mental attitude that has changed: The client is no longer being asked to be the final tester; the vehicle has to be quasi perfect when it leaves the plant.

Romorantin's brand new production facility represents a limited investment: 300 million francs [Fr]. The choice of an all-plastic body, as in the previous model, explains to a great extent the modesty of this investment. The plastics technology limits such investment considerably by eliminating the need for costly metal-stamping presses and by reducing the metalworking operations (body welding). On the other hand, since the plastics technology does not readily lend itself to automation, its production costs are basically higher: Today, it takes 40 hours to manufacture an Espace, versus 16 to 17 hours for mass-produced metal-bodied cars such as the Citroen ZX and the Renault Clio. With the introduction of automation at the assembly stage, and partial though this automation may be, however, this differential between very different cars tends to narrow. Matra, for its part, estimates that, for production rates up to 550 cars per day, the plastics option is still more economical than the metal.

Bonding of Composite Panels, Water-Jet Cutting, UV Treatment

At Romorantin, the Matra Quality philosophy is best expressed in the evolution of three operations: The bonding of the composite-material panels, water-jet cutouts, and UV [ultraviolet] surface-treatment prior to painting (see box [at end of this article]).

Although the welding of the sheet metal frame is a manual operation, as is also the fabrication of the plastic body-panels (SMC: Sheet Molding Compound), the six American-made GMF robots installed at Romo 3 handle the bonding, water-jet cutting, and painting operations. Each of the first two of these robots, positioned on either side of the previously welded hot-galvanized metal frame, deposits a 25-meter bead of a two-part polyurethane cement which provides adhesion, moisture-proofing, and stiffening. Each Espace thus receives 6 kilograms of this cement in 3 minutes.

The frame then moves to one of the new installation's major stations: The automatic composite-panels assembly machine. The panels are placed on jigs and are kept perfectly positioned by means of suction cups. The jigs then swivel and press the panels against the metal frame so as to bring them into contact with the cement bead. Inductors embedded in the jigs then go into action and speed up the polymerization. It takes not less that 84 inductors, supplied by the Swedish company Elva, to perform this spot-bonding, the principle of which brings to mind the spot welding of metallic bodies. The polymerization takes 2 minutes. Each panel is bonded in position at six points. Formerly, these operations were all done manually, from the depositing of the cement to and including the riveting. The new method is faster and results in body work of a geometric precision that was unattainable with manual riveting (0.1 mm).

The cutouts in the panels have undergone the same substantial quality improvement. This too was a manual operation. Today, it is performed by two robots manipulating a water jet in three dimensions. To replace the manual cutting operation, Matra chose this method over that of mounting a milling cutter on a robot and over the use of a laser: "The water jet eliminates the dust pollution that a miller normally generates, and poses none of the fire-hazard-related problems we fear in connection with the laser," they say. In this regard, Matra has benefited from the experience acquired by Renault on the Alpine model. It retained Saunier-Duval Electricite [SDEL] as prime contractor for the installation, which represents an investment of Fr2.5 million. Christian Francois acknowledges that the main difficulty lay in the tight delivery schedule imposed: Less than six months from date of order to the putting of the system into service. Guy Martin, manager of SDEL's water-jet activities, points with pride to the company's performance from the standpoint of the timetable: "We had the deuce of a time completing the job in the 2 and ½ minutes that were given to us," he says. In any case, the gain in productivity is far from negligible: It took a team of five to six persons from 10 to 15 minutes to complete the manual operation. And the quality has improved significantly: The two robots have considerably improved the precision of the cutouts for the fixed rear side-windows, the sun-roof, and the tail-lights. The deviation from design dimensions is held to within 0.5 mm by the two robots, versus 3 mm by manual cutting.

Concurrently with its technical work on the installation, SDEL trained five persons in the maintenance of the system, at its Bar-le-Duc center. This represents but a part of Matra's outlay on training. The robots, automatic machines, and programmable automatons used in Romorantin's new plant compelled the manufacturer to hire some 10 high-level automation technicians, a qualification that formerly had no place or reason for being in the company. These technicians received a one-week training course in robotics at GMF, and some 30 persons were trained to maintain the installation, under three distinct specialties: Electricity, mechanics, and programming. All courses under the training programs provided by the suppliers (GMF, and Saunier-Duval) had a duration of 1 week. "Today, the personnel still need to acquire certain responsive reflexes in connection with the use of automated procedures, such as that of checking each operation as it is performed," says Christian Francois. Mastery of these reflexes should result in the elimination of the remaining dysfunction in the production process.

[Box p 47]

UV Surface-Treatment for Composite-Material Bodies

For the new Espace, Matra has also introduced an innovation in the surface treatment of body components. These components, made of SMC, a polyester-matrix composite, must be surface-treated for better adhesion of the paint that is to be applied. In this regard, Matra has chosen an ultraviolet irradiation process developed by the G2M

company, in lieu of chemical etching (in an acid or alkaline environment), and of "stippling," a treatment used for the first generation of Espace.

"UV treatment has all the advantages of conventional processes," they say at Matra, "but not their disadvantages. First of all, it improves the adherence of those pieces that come from the mold coated with the stripping agent, and unlike "stippling," which consists purely and simply of rough-grinding the surface, UV treatment does not change the geometry of the piece. And secondly, it avoids the problem of effluents, an inevitable by-product of chemical treatments."

Originally developed jointly with Renault for the surface treatment of polypropylene, UV treatment was first extended to composite materials, on parabolic reflectors for headlights, at Valeo. But this is the first time its use is being extended to body components made of composites: rear door, fenders, bumpers... These are components with surface areas of up to 1 square meter. Specifically, UV treatment is applied to surfaces that have previously been washed with distilled water and dried. Once irradiated, these components receive paint (epoxy/polyurethane) which is then polymerized in an annealing oven.

Germany: Bosch Develops Data Base to Control Auto Electronics

91MI0321 Duesseldorf HANDELSBLATT in German 2 May 91 p 16

[Article by Eberhard Seifert: "Data Exchange Via a Single Cable"]

[Text] In the future, a data bus will bring order to the jumble of cables under the motor hood. At least this is the intention of automobile fitter Robert Bosch GmbH of Stuttgart. The company presented the new technology at a briefing in Schwieberdingen.

The new Mercedes-Benz S-class already has a fast data bus to handle continuous data exchange between its major control devices, which are linked in network. In this way, complicated control operations can be performed on the engine and drive system. In the BMW 850-i Coupe, too, instrumentation and body electronics information is transferred digitally over a cable using a multiplex system with a standardized power and data line. At the meeting in Schwieberdingen there was unanimous agreement that these examples would cease to be exceptions in the future.

In the future, high-speed buses (with a transfer rate of up to 1 million digital data per second) should be installed as standard fittings to handle data exchange between individual control devices in cars and trucks, and low-speed buses or "multiplex systems" (10,000 to 100,000 bit/s) are likely to be used to link the electrical and/or electronic systems in the car body.

"Bus" in this case means a wiring system that simultaneously links all points via a single cable. Multiplex systems are also configured as buses. In future, special communications buses linking carphone, radio, navigation system, and a mobile office will also come into play. The individual wiring in use until now, which takes a long time to make, is increasingly unreliable and is time-consuming to replace, will thus become completely obsolete.

In the dashboard alone there are often more than 100 cables and plugs—until now the most common source of faults—to be installed to connect instruments and devices. Some luxury automobiles have more than 60 cables leading into the driver's door alone.

Moreover, the number of electronic systems in a car is steadily increasing. One only has to think of electronic engine control with fuel dosage regulation or the anti-locking system, sometimes even with integrated acceleration skid control. Valve and gearbox control and controlled exhaust recycling provide further means of meeting the stricter consumption and exhaust regulations. Adjustable chassis, electronically controlled front- and rear-wheel steering, and the forthcoming navigation and guidance systems designed for more rational road use are also worth mentioning.

However, all these systems interact with one another. Thus, in a skid, acceleration control reduces the torque on the driving wheels by acting on the ignition system or the electronic engine output control. The requisite pulses were previously transmitted via a number of dedicated cables, with the result that the cable harness grew larger and more complex as each new component was added.

The multiplex system was developed to ease this situation by transmitting a variety of signals over a single cable. However, before this technology can be deployed, the type of transmission—nowadays mostly digital—the type of coding, the addressing mode, the sequence, and the error recognition and elimination system must be precisely specified in a transmission protocol.

Error-free real-time transmission requires further consultation on the transmission medium (copper wire or optical waveguide), the transmission speed, and whether the signals are to be presented as voltage or impressed current.

Here the experts talk of bus-coupling or the physical layer. The circuit that implements the protocol and the coupling is called the bus interface. It can be developed as an individual IC (integrated circuit) or integrated directly on a microprocessor.

The CAN ("Controler Area Network") proposed by Bosch will meet the many demands made on a reliable automobile data transmission system with a minimum chip area. It should be easy to integrate and cheap enough for use even in the car body for seat adjustment, air conditioning, or in the doors.

BIOTECHNOLOGY

Dutch Government Prolongs Biotechnology Commitment

91ANO379 Rijswijk BIOTECHNOLOGIE IN NEDERLAND in Dutch Apr 91 pp 36-37

[Text] The Ministry of Economic Affairs and the Ministry of Education and Sciences will continue to support the development of biotechnology over the next few years. The industrial-scientific and the social aspects are to be considered. This is the scope of the ministries' response to a recommendation made by the Strategy work group in March 1990 following the completion of the Innovation-Oriented Research Program (IOP) in biotechnology.

The Strategy work group represents biotechnology researchers (Dutch Biotechnology Association), the Netherlands Industrial and Agricultural Biotechnology Assocation (NIABA), and the Advisory Committee of IOP's biotechnology project.

The development of biotechnology is to be supported by encouraging the establishment of one or more academic research centers of international repute. It is essential that this objective be linked to the training of researchers (research institute). The Dutch Organization for Scientific Research (NWO has been invited, together with universities, to formulate proposals to this end. Furthermore, the Minister of Economic Affairs has announced that additional funds will be made available to inform the public about biotechnology and research into the behavior of genetically engineered organisms in the field.

Italy: International Genetic Engineering Center Described

91MI0355 Turin MEDIA DUEMILA in Italian April 91 pp 28-37

[Article by Laura Capuzzo: "Welcome to Trieste's Health Industry"]

[Exerpts] [Passage omitted] UNIDO's (United Nations Industrial Development Organization) ICGEB (International Genetic Engineering and Biotechnology Center), located near the Yugoslav border in the rugged Carso area around Trieste, has been consolidating its position over the past few years. [passage omitted]

The center was established with funding from the Italian government (34 billion lire) and the Trieste Research Area [scientific park] (45 billion lire funding for building construction). Subsequently, an interesting "sliding" five-year funding system was adopted to avoid the precarious nature of annual programs. Professor Arturo Falaschi [ICGEB director general] described the system as follows: In July 1989, funding was distributed over five years and by June 1990 it was extended for another year with additional funds. Therefore, after the first 12 months, a second five-year program was launched. This program is now under way and has allowed the center to program its activities through June 1995. By the end of this year, at least 24 countries will probably ratify the agreement to establish the center. According to its statute, this will formally transform UNIDO's special project into an independent intergovernmental organization funded by the participating countries on a yearly basis.

By all accounts, therefore, the ICGEB appears to be growing steadily and at an exceptionally fast rate. Less than four years after its establishment, all the activities envisaged in its statute have been launched and, to the managers' pride, are fully operational. The staff in Trieste comprises about 90 researchers, students, engineers, and clerks, with some positions still vacant. Another 70 work in the New Delhi center. Falaschi recalled: "We became fully operational in 1990, after having identified research areas for our programs." The New Delhi center gives priority to biotechnology studies with applications in agriculture, while the Italian laboratories specialize in projects with industrial applications, with special reference to the so-called "health care industry."

Ever since the first programs were launched in 1989, research in Trieste has been driven by health care needs and in particular those of the third world countries. Prof. Falaschi's molecular and cellular biology group, which works in close contact with the genome group led by the Italian Claudio Schneider, carries out basic research on human DNA replication mechanisms. The studies are designed primarily to ascertain why cancer cells proliferate in the human body. Sophisticated and innovative techniques are used for automatic macromolecular microimplantations into the nucleus of cells and for the simplified purification of cloned DNA fragments.

The general research topic is then divided among other interacting groups that deal with more specific topics for better operational results. For example, the virology group under Lawrence Banks from the UK studies the human papilloma virus, which is considered to be the main cause of tumors of the female genital tract, primarily the cervix of the uterus. Papilloma is related to polyoma, the object of Dulbecco's studies, and to SV40 in monkeys, and attracts the scientist's attention because it is the cause of infections that can degenerate and become one of the most frequent causes of female deaths in tropical areas, and is a source of suffering in industrialized countries.

Professor Barralle's molecular pathology group, instead, is studying various applications of genetic engineering in medicine and the genetic factors that make some people more susceptible to common diseases such as lipoidoproteinosis (high percentage of lipids in blood) and hypertension. The latter, although commonly associated with the stress of lifestyles in the West, is extremely widespread in Africa, too. New inhibitors for the AIDS virus are being sought, as well as new methods to develop vaccines against infectious diseases. Eosinophils, blood phagocytes that increase in number with parasitic diseases, have recently become the target of research activities.

The microbiology group, which basically works in the area of the improved use of vegetable biomasses, seeks primarily to obtain microbe-induced lignin degradation. Unlike cellulose, the lignin found in wood, straw, and fodder, is

difficult to degrade, creating a series of problems in industrial paper production for example. Lignin is responsible for considerable raw material waste (according to estimates, only 15-20 percent of the wood intended for this purpose in Italy is actually used) and wear to industrial equipment. Accordingly, manufacturers are obliged to resort to using highly polluting chemicals for periodic cleaning work. Group leader Professor Carlo Bruschi emphasized that using biological methods to attack lignin would also be more environment-friendly than chemicals. Furthermore, a biological lignin decomposition system would not only benefit industry. The group is also carrying out animal husbandry studies with a special emphasis on developing countries. Their objective in conjunction with the University of Udine is to increase the nutritional yield of fodder by identifying the microorganisms in the rumen of cattle that improve fodder assimilation.

Professors Sandor Pongor from Hungary and Oscar Burrone from Argentina lead two teams that play a complementary role with all the other groups. Prof. Pongor has brought with him his knowledge of the relationship between the structure and function of proteins, namely molecules that are essential in all cellular processes, including DNA replication and lignin degradation. Prof. Burrone studies molecular immunology and in particular the characteristics of the rotavirus, which is responsible for a large number of often lethal cases of diarrhea in children in tropical countries.

However, UNIDO's genetic engineering center carries out other activities. Prof. Falaschi pointed out: "We attach great importance to the short- and long-term training of our researchers." The latter includes one- or two-year scholarships (over 30 were granted last year) for young scientists from the member countries to enable them to participate in ongoing research programs at the Trieste and New Dehli centers, as well as in certain Italian research institutes. Furthermore, in collaboration with Trieste's International School for Advanced Studies, the center has recently provided scholars with an opportunity to complete their training with a three-year international molecular genetics doctorate.

Short-term training, instead, consists in one- or two-week theoretical or practical refresher courses and in a few specific conferences on advanced topics. Every year, about 5-6,000 specialists in the main genetic engineering areas attend these events. About 15 are scheduled for 1991, "among which," Prof. Falaschi pointed out, "three courses on the molecular genetics of yeast, bacterial genetics, and the applications of automatic calculations to molecular biology, that have become a successful tradition at the center. Thanks to the availability of laboratories, this year the first course will include a practical session in addition to a theoretical session."

Affiliated centers are entirely responsible for the collaborative research program, which receives about 1 billion lire per year from the ICGEB. Every year, each affiliated center submits a series of projected research programs to a committee of international experts for their evaluation. The programs that get top ratings are granted up to $35,000 per year for a maximum of three years.

Finally, the ICGEB provides the member countries with sophisticated scientific services enabling them to maintain high research standards. Services range from the supply of particularly valuable reagents to consultancy on research programs or the construction and organization of new laboratories for genetic and biotechnology research. Prof. Falaschi pointed out that the center is particularly proud of a recently installed telecommunications network that assures connection with national laboratories and provides access to data bases on human and other genome sequences, as well as on the sequences of various biological macromolecules. In Prof. Falaschi's words: "This is an important element since it facilitates studies in recently established scientific structures."

Italy: Plant Genetic Engineering Law Proposed

91MI0351 Milan ITALIA OGGI in Italian
10 May 91 p 19

[Text] By October this year, Italy will have its first law governing the "field" experiments of transgenetic plants, that is, plants obtained through genetic modification. The regulation is being drawn up by the Ministry of Agriculture and will regulate the emission into the environment of plant organisms created in laboratories.

The technique is a highly risky one. The new genetically modified plants can, in fact, affect the life of an ecosystem in various ways, for example, by entering into competition with local species and causing their extinction. According to experts, the indirect effects may become evident only after several years. For this reason a consortium will be established this summer to coordinate Italian research on environmental genetic engineering, following an announcement made at a conference held yesterday at La Sapienza University in Rome.

"The organization of the sector," stated the Minister of Universities and Research, Antonio Ruberti, "is in line with the EEC's policy, which has recently approved 600 billion lire in funding over four years for agriculture."

For the rector of the university, Giorgio Tecce: "Plant genetics is a sector in which Italy is in the forefront. Our country can therefore be competitive on the international level but we lack the facilities and funds."

Italy, because of this regulation, will make great steps forward. "The law," explains molecular biologist Paolo Costantino, "will permit the passage from tests in laboratories and greenhouses to field work, naturally in small areas and with rigorous controls. The latter is necessary to verify the effects of large-scale transgenetic cultivation."

The law will establish, in particular, which DNA-modified plants can be cultivated in open fields and which only in greenhouses. This will depend to a great extent upon the processes with which they have been obtained.

Among the other projects to organize plant genetics research in Italy, Minister Ruberti has proposed establishing a national institute of biotechnology applied to agriculture, open to universities and research institutes, and based on the model of the National Institute of Nuclear Physics.

The minister concluded by saying that priorities and resources for plant genetics will be established in the three-year 1992-94 research program envisaged under the new law.

Germany's Abicap System Aids Monoclonal Antibody Production

91P60239 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 31 Jul 91 p 8

[Text] The detection of immunoglobulin G is an important step in the production of monoclonal antibodies. The firm Abion oHG (6 Schuetzenweg, 8174 Benediktbeuren) has now developed a detection technique which should significantly simplify this detection [procedure]. Furthermore, Abion hopes to develop other Abicap systems for the diagnosis of infectious diseases and for detecting pollutants in comestibles as well as in the environment. As Dr. Ursula Erhardt (Abion) further explained in this connection, immunoglobulin G is normally detected by using the ELISA [enzyme-linked immunosorbent assay] test. Like the Abicap method, this test operates on the basis of an immune reaction. The substance to be detected is the antigen to which a tagged antibody bonds. The ELISA test operates with small closed vessels. What is peculiar about the Abicap system is that it makes use of a small one-way column in carrying out this procedure.

To this, several advantages accrue. One of these is that the combination of antigens and antibodies occurs while the test sample is flowing through the column. The diffusion steps required by the ELISA test are thus dispensed with. The complete bonding of antigens to antibodies, which takes several hours using the ELISA test, occurs within a minute.

Furthermore, under normal circumstances, the bonding reaction using the ELISA test would be discontinued after a short interval, so that a result might be gained only after comparison with a [standard] reference substance. Allegedly, using the Abicap system, these comparative measurements are unnecessary. Moreover, using the Abicap [system], the effective surface for the bonding process is greater. In one Abicap-30 [system], up to one microgram of antigens bonds [to antibodies]. Thus, the process is also suitable for enriching substances occurring in more dilute form in a solution.

Dr. Erhardt is counting on an ample market for the Abicap system. In a large industrial concern involved in antibody production, up to 500 test samples per workday can be used as starting material. Projected in terms of the 15 largest firms in the pharmaceutical and diagnostic agent sector, this corresponds to a demand of 1.5 million tests per annum. Such tests are called for in fermentor testing and other operations prior to actual production as well as in controlling the activity of antibodies during production and in the purification [phase].

COMPUTERS

International ODA Software Toolkit Development Group Founded

91MI0345 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 24 Apr 91 pp 4-5

[Text] IBM, DEC, Unisys, The Bull Group, Siemens Nixdorf, and ICL (Fujitsu) have founded the "Open Document Architecture" (ODA) consortium. The group intends to promote and develop a standard for document exchange that will allow multinational companies, in particular, to exchange documents consisting of text, graphics, and audio material. They plan to develop by 1993 a "software tool kit" on which applications for ODA specifications can subsequently be based. It is planned to licence this kit freely to software and other computer companies. ODA, developed by the International Standards Organization (ISO), as a whole lays down a series of standards for structuring and coding documents for data exchange but still omits essential criteria, for example, for audio transmission and spreadsheets.

However, the breakthrough to a new standard is now imminent, says Prof. Hans Georg Musmann, director of the Institute of Theoretical Communicatons Engineering and Data Processing at Hannover University and one of three specialists on the ISO committee addressing transmission standards for digitalized audio and video signals in normal cable networks and/or in normal radio and television frequencies. Digital radio will begin in Paris on 27 April, he says.

The 14 candidates who submitted hard- and software proposals for digital radio signal transmission to the ISO committee were recently formed into four competing groups, which presented their proposals for solutions. Two groups proved unviable, whereas the other two were basically very similar in their solution strategies. The new standard will now be drafted from these two concepts.

According to Musmann, there is yet another revolution on the way that will turn the entire video and audio market upside down: A new type of recorder that dispenses entirely with mechanical scanning systems is not far off. New techniques make it possible, for instance, for a chip to contain all the video and audio information for a one-hour film, broken into 0-1 sequences, or, in other words, digitized. This trend will make the CD player obsolete; and for video recorders there will be a technological leap to the central media computer.

The compact disk will stay in the game for a while as an "interim technology," because the silver disk is just overcoming its last drawback: the fact that, once stored, its contents cannot be modified.

New erasable and rewritable optical high capacity recording disks and drives have just been presented at the

Sixth Annual Multimedia and CD-ROM [compact disk read-only memory] Conference in San Jose.

IBM presented a 128-Mbyte, 3.5-inch drive with an access time of 66 milliseconds. Phillips & Du Pont Optical showed a 5.25-inch, 1-Gigabyte drive with an access time of 30 milliseconds.

New German Software Facilitates CTM, Unix Compatibility

91WS0368A Vienna DIE PRESSE in German 9 Apr 91 p 1

[Article: "Successful Connection: CTM Uers Can Breath Again"]

[Text]Several hundred users of Mueller Computer Technology (CTM) computer systems can breathe a sigh of relief. Thanks to the Itos 3020 Unix Server, they can now use their CTM hardware and software under Unix as well. Along with the Itos XMS package, this multiprocessor server can also handle the entire library of over 200 available CTM complete solutions and also network in CTM peripherals.

Money Not Wasted

As a result, the money spent by Itos XMS users on CTM software, CTM networks, and CTM workstations will not have been wasted.

Itos XMS is a Multix-based system-oriented software. Multix is an AT&T V.3 Unix-compatible multiprocessor. Itos XMS serves as an interface to the CTM world and manages the on-line CTM-LAN (local area network) and CTM workstations. The hardware base is a Unix-based Itos 3020 computer equipped with two processor cards (Motorola 68030/33 MHz) and a 32 megabyte memory. The Itos 3020 takes care of data storage and management, i.e., the typical server functions. Communication between the Itos 3020 and the on-line CTM workstations is accomplished via XMS software. CTM workstations linked to the ITOS 3020 can run either Unix applications or the multistation solutions of the CTM world. This means that the user at his workstation has full access to the functionality of both of these operating system/software worlds. When performing multitasking operations, he has access to them simultaneously.

Naturally, all the interfaces necessary to the Unix environment (Ethernet, smart terminals, etc.) can also be used with the Itos 3020. Consequently, an Itos 3020 server equipped with Itos XMS software can be used as a "pure" Unix computer.

Unix Platform at a Minimal Expense

The XMS concept is, of course, targeted primarily at the existing CTM user, who - with his industry-specific complete solutions - can be found in fields such as manufacturing, publishing, printing, commerce, medicine, and even law. All of them can create a Unix platform easily and at minimal expense by merely exchanging their CTM server for an Itos 3020 server equipped with XMS software. They can even use the great majority of their peripherals (controller, mass storage unit, etc.) with the Itos 3020. Interestingly enough, however, the Itos XMS package is also targeted at Unix users who want to combine the more economical Unix-based cabling available through the Itos LAN with the capability of CTM workstations to provide more rapid throughput than is available with Unix.

With its XMS package, Itos Computers, whose subsidiary company recently established an office in Vienna, offers existing CTM users the optimum means of combining the advantages of tried and true CTM application solutions with the versatility of the Unix world. I

German Researchers Offer GAAS Alternatives to Cray Supercomputers

91WS0368B Duesseldorf VDI NACHRICHTEN in German 17 May 91 p 16

[Article by Bernhard Rose: "Supercomputer Computes With Gallium-Arsenide Chips: Research Institutes and Industrial Firms Want To Process Huge Data Bases Faster"; first paragraph is VDI NACHRICHTEN introduction]

[Text] High performance processors with Gallium-Arsenide chips are the secret behind the new Convex computer. With performance in the Gigaflop (Gflop) range, the leader in the minisupercomputer market now wants to take on Cray.

"Now the person who has never been able to afford a Cray has a second option," declares Helmut Muehl-Kuehner, manager of Convex' Frankfurt office, self-confidently. Until now, Cray users have used the Convex primarily as a backup for the huge number-crunchers. Now, however, the leader in the minisuper market is ready to challenge Cray directly.

The new convex C3 is certainly capable of doing so. With an option of up to eight parallel central processing units (CPU), the new high-performance computer from Texas has a peak performance of two billion floating-point operations per second (2 Gflops) at a 32 bit word size, or 1 Gflop with the 64 bit applications more prevalent in the supercomputing world.

This puts the Texas computers in the same range as the Cray Y-MP, which, with four processors, has a peak performance of approximately 1.3 Gflops (64 bit). "We can match that with no problem," says Muehl-Kuehner, because the critical factor is how well the computer performs when running applications.

Convex claims that the eight-processor C3 is approximately 30 percent faster than the Cray Y-MP/832 when computing finite-element programs such as Ansys S2, which is difficult to vector or parallel process. And in the benchmark test that uses the Monte Carlo transport code to calculate propagations in turbulent flows, the single-processor C3 was reportedly still 55 percent faster than the Y-MP/816, making it equal to a Cray-2.

According to Muehl-Kuehner, the C3 is as attractive financially as it is technically. prices range from 3.5 to 12.5 million German Marks [DM], depending on configuration. Furthermore, with an electrical load of only 45 kW, the computer will actually save money when it comes to operating costs. The reason: computer logic made of the promising new semiconductor material Gallium-Arsenide (GaAs). The new top of the line is "the first supercomputer with microprocessors made of gallium arsenide," says Development Head Stephen Wallach.

A characteristic feature of chips made of gallium arsenide is that they not only are able operate at a higher clock frequency, but also consume only 20 percent to 25 percent of the electrical energy typically consumed by CMOS (complementary metal-oxide semiconductor) or ECL (emitter-coupled logic circuits). This tremendous advantage means that the new number-cruncher, like all previous Convex computers, requires only air cooling.

One is immediately struck by the shape of the new Convex: four 6-foot high CPU cabinets fan out in a semicircle from the main memory. Each cabinet contains two powerful CPU motherboards, each 0.5 m^2 in area, 20 kg in weight, and densely covered on both sides with electronics. Each motherboard has its own power supply. The sole connection between each motherboard and the outside world is one thousand pins.

The C3 has gallium-arsenide chips in approximately 30 different chip designs as gate-arrays, all produced by Vitesse Semiconductor at a line spacing of 0.8 µm. The largest chips consist of up to 45,000 logic elements. The clock rate is 60 MHz.

The main memory is equally large; with up to 4 Gigabytes (GByte) it is double that of the C2. With 4 GBytes, there is considerable space for virtual memory as well. This is extremely important in supercomputing, where the calculation program is often too large for the (physically present) main memory.

The so-called crossbar is also tailored to the throughput. The crossbar is a poling device equipped with much faster logics, via which every CPU with at least 500 megabytes of bandwidth has instant access the main memory. With eight CPU's and a central input/output port, the crossbar as a marshaling yard handles up to 4.5 GBytes of data.

"Everything is in giga now," exults marketing chief Dr. Harald Meier-Fritsch, "gigaflops, giga memory, and gigabyte per second." Such incredibly rapid data input and output has become necessary primarily because of the increasing number of tasks for which supercomputers are used.

Aside from the classical task of serving a multitude of work stations performing tasks such as the analysis of mechanical or chemical problems, there is a growing need for high performance file servers and data base computers with short response times. For example, the Heidelberg Cancer Research Center needs a Convex C2 minisupercomputer (Convex C2) as a straight data base computer for the sequential analysis of proteins.

In addition, the computer center at the University of Stuttgart found itself in a bind where the rapid manipulation of their enormous database was concerned: Although the scientists used their Cray 2 for calculations, they needed an additional Y-MP strictly for the management, retrieval, and conversion of data.

"There is also an enormous demand for high-performance network and file servers in industry." Muehl-Kuehner is alluding to the ever-growing number of networked workstations in business firms. Of particular importance are commercial applications such as those for searching for data in huge corporate databases. "Anyone not still using obsolete COBOL programs will do fine with a Convex."

Muehl-Kuehner estimates that the German market potential for the new C3 flagship, a potential which Cray and other computer companies have left untapped, is approximately 50 units. This comes as no surprise, as there is to date a huge gap in Germany between the DM5 million and the DM15 million price classes.

Hyperstone's E1 RISC Processor Described

91WS0364 Berlin RADIO FERNSEHEN ELEKTRONIK in German Mar-Apr 91 pp 161-163

[Article by Otto Muller: "Inexpensive Alternative: The E1, Hyperstone's RISC Processor"]

[Text] There are now several types of 32-bit microprocessors designed according to classic architectures. The development of the Hyperstone E1 RISC [Reduced Instruction Set] microprocessor took a new direction. This article introduces the E1.

If you want to design a 32-bit high-performance microprocessor today, the formula is obvious. You take 32 registers, a 3- operand instruction set with simple instructions and fit them into a 32-bit instruction word. However, what will the price be? The most often heard argument runs like this: Forget memory costs and trade off instruction size with simple decoding to get maximum speed. However, in the first place, a 32-bit instruction word doubles the program length compared with compactly coded instructions. In the second place, memory prices are still a cost factor depending on the application. In addition, these arguments do not address the most important point, that is, balancing the instruction set and memory bandwidth achieves the greatest speed. These two characteristics are subtly linked together. The printed literature, however, usually overlooks this. In CISC [Complete Instruction Set] architectures, execution taking several cycles usually slows powerful instructions. However, these architectures require a small memory bandwidth. In RISC architectures an instruction word having a constant length of 32 bits needs a higher memory bandwidth compared with a 16-bit instruction word. Using a Harvard architecture with either two separate memory busses or at least one additional large cache memory achieves this increased bandwidth. However, using a 16-bit instruction word reduces the necessary memory bandwidth so much that even a small integrated cache does not reduce the CPU [central processing unit] speed via wait states.

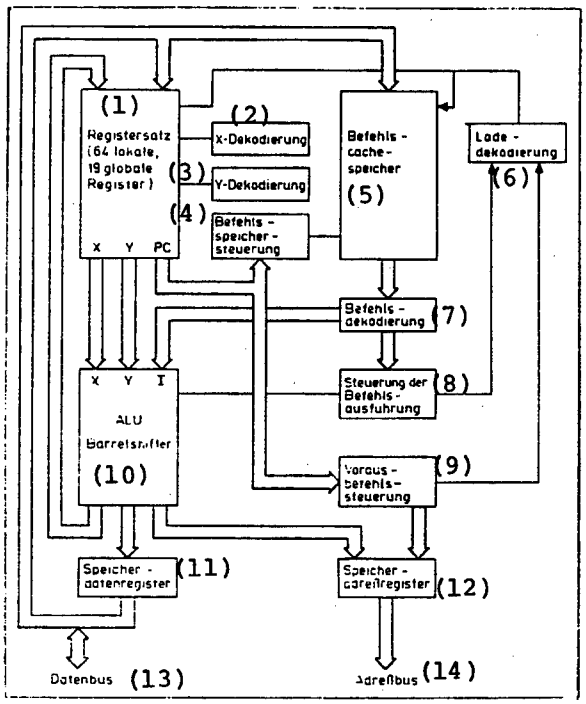


Figure 1: Block diagram of the Hyperstone E1 processor
Key: 1. Register set (64 local, 19 global registers)—2. X decoding—3. Y decoding—4. Instruction memory control—5. Instruction cache memory—6. Load decoding—7. Instruction decoding—8. Instruction execution control—9. Instruction prefetching control—10. ALU barrel shifter—11. Memory data register—12. Memory address register—13. Data bus—14. Address bus

On the next argument, the increased costs of a second memory bus or a large cache memory are worthwhile. This is because a 32-bit instruction word makes it possible to use powerful 3-operand instructions. The author's experience shows that only a negligible percentage of 3-operand instructions use a register variable as the third operand. Only 1.5 percent of all instructions in a program require an additional preceding MOVE instruction if the instruction set includes only instructions using two variables. These considerations form the basis of the new Hyperstone E1 microprocessor. Figure 1 shows its block diagram.

The microprocessor uses a variable instruction format of 16, 32, or 48 bits. The basic instruction length is 16 bits. Extensions to 32 or 48 bits allow the use of constants of up to 32 bits as direct operands. The regularity of the instruction formats permits fetching instructions from the integrated cache memory and decoding them in only one cycle. The next cycle is the execution cycle. The resulting pipeline length of only two stages makes possible quick refilling of the pipeline following branch instructions. A deferred branch instruction with a destination in the instruction cache executes without wait states. This is an advantage over architectures having a longer pipeline. As executed branches represent about 20 percent of all dynamically executed instructions, each additional pipeline stage slows the CPU by about 20 percent again!

A 16-bit instruction uses 5 bits to address the 32 destination registers and 5 bits to address the 32 source registers. As an alternative, you can specify a 5-bit direct operand instead of a source register. In this way, you can represent the 32 most-used constants. An extension by 16 or 32 bits only becomes necessary for longer and less-often-used constants. The other 6 bits of the instruction suffice for coding a powerful instruction set.

Sixteen of the addressable registers are global registers. The instruction counter and the lower-order 16 bits of the status register can be addressed as global registers. In this way, special instructions for dynamically coded branch instructions or to set flags are unnecessary. The other 16 registers represent the current stack frame within a local 64-register stack. A stack frame has a variable length of up to 16 registers. It may overlap the preceding stack frame.

On average, a stack frame requires eight registers. Due to this, a local register stack having 64 registers is at least as efficient as a register stack having 128 registers and a constant-sized stack frame. Besides, the number of registers overlapping the previous stack frame is variable in the Hyperstone processor. The subroutine that is the transfer target specifies the overlap and size of the stack frame using a frame instruction. The variable parameter passing method made possible in this manner greatly simplifies compilers because the compiler does not need any information about separately compiled and linked library routines. If the newly created stack frame does not completely fit in the local register stack, the contents of the oldest stack frame is automatically stored in the memory portion of the stack. This stack frame is stored either completely or partially according to the space required. A return instruction checks whether the return stack frame is still completely in the register stack. If this is not the case, the portion that is not in the register stack is reloaded from the memory portion of the stack. On average, a sequence of eight subroutine calls or eight return instructions can execute without push or pop operations. On average, fewer than 1 percent of the executed subroutine calls or return instructions need a push or pop operation.

Only load or store instructions via a pipeline access the memory. Following a load instruction, the microprocessor continues with instruction execution. It stops only to access data not yet loaded. The available memory data types are byte and half-word with or without sign, word and double word. Bytes and half-words undergo zero-extention or sign-extension before being loaded into a register. Register instructions process only entire words or double words.

The available addressing modes are register address, register postincrement, register + displacement (including PC-relative), register - displacement with postincrement, absolute, stack address, I/O absolute, and I/O displacement.

An external MMU [memory menagement unit] provides virtual memory management using demand paging. Page faults can be corrected. Most single-word instructions execute in one cycle.

Branch instructions are available in two groups. These are immediate branches and deferred branches. Each group consists of unconditional and conditional branches with 12 conditions. Branches located from -128 to +126 bytes, relative to the instruction counter, may be addressed using one 16-bit instruction. Branches to points farther away require a 16-bit extension. Floating-point instructions are integrated into the architecture. However, the hardware of the current version does not implement them. These instructions are trapped to a subroutine.

In the Dhrystone benchmark, 76 percent of the instructions have a length of 16 bits. The additional chip area needed for variable length instructions is negligible.

One 128-byte cache is integrated onto the chip. This cache is a combination cache and buffer memory. A good hold-and-load strategy yields hit rates comparable to those of much larger cache memories.

It was not easy to find the best balance between instruction prefetching and data access. As only one address bus and one data bus are available, careful management of the memory bandwidth was necessary. Using dynamic memory in page mode as much as possible was the only way to achieve the required high bandwidth. A small group of five engineers designed the Hyperstone microprocessor. They financed the project exclusively with their own money. After finishing the architecture definition, the logic design and layout of the circuit on silicon took only 12 months. Only two engineers did the logic design itself, including complete documentation, simulation, and trouble-shooting. For this task, they used a hardware description language, designed by the engineers themselves, with the maximum degree of abstraction.

The primary strength of this language is describing regular logic structures. A register is, for example, a one-dimensional array of flip-flop cells. A memory is a two-dimensional array of memory cells. Index subranges, concatenation, and alarm repetition are also available. A few hundred statements described the entire microprocessor instead of the usual square meters of circuit diagrams. Designing without circuit diagrams saved several steps. First, transferring abstract logic relationships to two-dimensional drawings is not necessary. That is, logic formulas may be simply written down. The designer need not think over and over about just how the individual modules must be located and connected in a circuit diagram. Second, entering the circuit diagrams in CAD [computer-aided design] format is unnecessary. This automatically cuts entry errors. Third, logic formulas, if the syntax is correct, are very easy to read intuitively and to understand. In this way, most errors can be discovered during proofreading.

Then, the logic formulas are translated into the format of an industry-standard logic simulator. The logic design would have taken at least 10 times as long without this hardware description language.

The processor consists of special 1.2 µm CMOS [complementary metal-oxide semiconductor] cells. These cells can be transferred to the polygon level in any CMOS process at little expense. Fabrication of error-free chips having a maximum speed of 40 MIPS [million instructions per second] with single-cycle instructions has already succeeded at the first try. This high processing performance is entirely available in loops. Using standard DRAM [dynamic random access memory] chips with a page-mode cycle time of 40 ns, a maximum speed of 25 MIPS can be obtained without an external cache memory. Using only 85,000 transistors reduces the chip size to 43 mm^2. This small size also allows the chip to function as a microcontroller core unit. An external cache memory is unnecessary. Due to this, systems where costs prohibited including a fast 32-bit microprocessor also can use the processor.

The Hyperstone processor has been optimized with a view toward embedded systems. A DRAM controller with RAS [row address select] and CAS [column address select] multiplexers, refresh logic, parity logic, and a programmable bus controller for all RAM [random-access memory], ROM [read-only memory] and peripheral modules, are integrated onto the chip. Systems using the Hyperstone processor can be built with few additional modules. System costs are low.

The E1 Hyperstone microprocessor is in production now. Besides the 144-pin PPGA [program package for general applications] housing, a QFP design is in preparation. A Hyperstone development system, including cross-assembler and debugger, is already available. A C compiler with source-code debugger will follow at the end of January. Program development uses a PC.

Italy: Neural Networks Research Project Described

91MI0357 Turin MEDIA DUEMILA in Italian May 91 pp 66-68

[Exerpt]

The International Situation

[Passage omitted] European research in the field of neural networks has always been supported primarily through national funding. This applies in particular to countries such as France, the UK, Finland, and the FRG. In 1988, for example, the FRG government decided to allocate over $100 million in funding over a ten-year period for neural network research through the "Information Processing in Neural Architectures" program involving eight research teams.

However, if Europe is to keep up with American and Japanese competition, close cooperation at both the academic and the industrial levels is imperative. Two recent programs—BRAIN [Basic Research in Adaptive Intelligence and Neurocomputing] and ESPRIT-II [European Strategic Program for Research and Development in Information Technologies]—lead in this direction. The goal of

BRAIN (an initiative of the EEC's Dg XII, launched in 1987), is to acquire a better insight into the workings of the brain and to design machines that are capable of replicating its problem-solving capabilities. A total of 28 laboratories with 100 researchers are involved in the project, which has been allocated ECU 2 million. The ESPRIT-II project deals primarily with practical applications, and is being carried out with the support of major companies (Thomson, Philips, Siemens, CSELT [Turin Telecommuncations Study Center]). It is divided into different levels: applications, special high-level languages, simulation techniques, parallel architecture support, VLSI [very large scale integration] and WSI [water scale integration] patterns. Two pre-competitive projects, called Pygmalion and Annie, have been launched as part of ESPRIT-II.

The Italian Situation

In Italy, research activity has been restricted to a few groups, some of which are well known abroad, such as the group directed by Professor Caianiello, who is internationally recognized as a pioneer in neural network research. Italian participation in European projects is also very limited. Over the last three years efforts have been made to coordinate the various groups involved in neural network research. A first step is the annual "Workshop on Neural Networks and Parallel Architectures" which has been held at Vietri sul Mare since 1988. In addition, Professor Gianni Orlandi has been coordinating neural network research at the national level with more than 150 researchers. These efforts led to the establishment of SIREN (Italian Neural Networks Company) in 1989. The international activites carried out by Italian researchers have promoted a European-wide joint initiative among the various national agencies (JENNI) to encourage cooperation among European partners. One of the first results of this initiative is the decision to organize annual European conferences on neural networks to foster closer contacts among researchers from various countries and for more effective cooperation between research and industry. The first conference took place in Paris in 1990. The 1991 conference will be held in Helsinki and the 1993 conference in Italy.

The current project is the outcome of these initiatives and its goal is to increase Italy's contribution at the international level and to organize its participation in European projects by coordinating the activities of Italian teams involved in neural network research. It may also provide a major contribution toward the definition of a strategic CNR [National Research Council] project on neural networks.

Research Plan

A research project on neural networks undoubtedly requires a number of years to complete and calls for considerable organization to develop, as a first step, the appropriate cultural enviroment. Research activities, therefore, will be carried out to meet the following requirements:

- Communication: Since the study of neural networks calls for a multidisciplinary approach, close connections should be established among the various groups involved in such research to ensure a continuous exchange of information and experimental data.
- Coordination: As noted earlier, this type of research requires constant coordination. Consequently, the goals of the program will be monitored continuously to assess the effectiveness of such coordination. National conferences and meetings will be organized for this purpose to discuss the results obtained and the validity of the line of research pursued.
- Competitiveness: Skills and professional know-how will be supported to improve Italy's competitiveness at the international level. This type of research which calls for synergies from several industries, can undoubtedly take advantage of our country's cultural heritage. It is therefore important to develop human resources in this field, especially by awarding grants and scholarships for young trainees.

Goals of the Project

The main object of this research project is to coordinate the activities carried out by the Italian teams involved in neural network research and enhance the role of Italian research at the international level. This project, therefore, is not an end in itself, but will lay the basis for in-depth research over a number of years and may lead to the development of a finalized project as a natural outcome of such efforts. Consequently, the following targets will be pursued:

- 1) promote basic research, which is indispensable;
- 2) ensure the development of human resources through field-work;
- 3) ensure a quantity of information which may be transferred at various levels;
- 4) provide continuity and a framework for nationwide development;
- 5) become a fundamental channel for exchange and participation in international projects, especially at the European level;
- 6) ensure technology transfer to industry.

The Goals of Research

In view of the above mentioned objectives, international development trends, and an analysis of the domestic market, the three-year "Neural Networks" strategic project, is designed to make use of the interdisciplinary contributions and know-how of the teams involved, to study neural models and architectures in order to develop neural processing machines. In particular, the three-year program envisages the following steps:

- 1) The study of neural network models and algorithms and the factors influencing the feasibility of such networks (in terms of speed, computational cost, parallelism).
- 2) The theoretical analysis of several major problems connected with implementation, including:
  —relations between neural models, classes of problems, and their coding

—the effect of network topology on the amount of information to be stored and on the quality of system response;

—the sensitivity of the system to any parameter error;

—the system's fault tolerance.

- 3) the study of parallel architectures capable of implementing neural algorithms.
- 4) The analysis and implementation of the models on large-scale parallel architectures, with special reference to problems concerning interconnection topology, scale, fault tolerance, dedicated circuits.
- 5) The development of software and hardware tools to create a testing environment for various general-purpose and dedicated neurocomputer architectures.

Projected Results

As pointed out earlier, the goal of neural network research is primarily to transfer know-how to research centers and industry. The main results to be achieved include: contributions to international magazines; contributions at national and international conferences; organizing seminars and workshops; software that simulates neural networks on conventional computers, on general-purpose parallel machines, and on dedicated hardware; hardware prototypes of neural networks.

Prospects

The development and applications of neural networks will provide the basis for innovative manufacturing processes and the creation of new manufacturing sectors. More specifically, the innovations that are already foreseeable include:

- new methodologies to develop associative memories;
  —technologies for robotics;
  —technologies for biotechnology;
  —new-generation computers (neurocomputers).

The program is expected to take three years to complete.

DEFENSE R&D

French Company Develops Triaxial Gyrolaser

91ANO390 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 18 Apr 91 p 20

[Article by Serge Brosselin: "The Tigre Helicopter Will Be Equipped With the First Triaxial Gyrolaser"]

[Excerpts] Sextant Avionique has just introduced in Chatellerault the world's first triaxial gyrolaser ever developed. The French-German [Tigre] combat helicopter will be the first to be equipped with it. [passage omitted]

The gyrolaser principle is based on the creation of a virtual platform by computation of data from gyrometers that are linked to the carrier motions. It is essentially this feature that enabled the gyrolaser to become the solution of the future for inertial navigation in hostile environments. The feat of the engineers at Sextant Avionique was that they were able to integrate three totally imbricated gyrolasers in a single optical unit. This integration leads to production cost reductions because some parts are shared by several resonant cavities (e.g., the mirrors). Because of the smaller number of mirrors, coupling phenomena can be reduced and, consequently, fewer corrective operations are required. Daniel Kolher, manager of the Navigation Division at Sextant Avionique, explained: "At comparable performance levels, the cost of the PiXYZ triaxial gyrolaser—which consists of three resonant cavities of 14 cm perimeter each—was about 14 percent lower than that of a system with three nonintegrated gyrolasers. In addition, as compared with similar systems with three distinct elements, a substantial reduction in size—on the order of 35 percent—was achieved."

Other Programs Under Consideration

This triaxial gyrolaser, which is unique in the world for the time being (the other two giants in inertial navigation, Honeywell and Litton, do not have anything equivalent yet), has been selected to be installed in the central navigation system of the French-German Tigre combat helicopter. Since the system will be installed twice on every helicopter, about 1,000 units of the PiXYZ (and of the associated Macsi accelerometers) will have to be developed just for this program.

Will the PiXYZ be selected for other programs? The manager of the Navigation Division revealed that this triaxial gyrolaser had been selected by the General Armament Delegation (DGA) for a major retrofit operation on the Transall military transport aircraft. This operation is to start later this year. The system may also be selected for some projects or programs on future missiles, such as the long-range air-to-ground missile (ASLP) or the Apache cruise missile. As to any licensing agreement or possible development of the PiXYZ in cooperation with U.S. companies, the management of Sextant said that it was open to any proposal. "The PiXYZ is patent-protected, but our industrial strategy leads us to be realistic. It is better to associate perhaps with an American company and obtain part of a market than to be alone and not have anything at all," Daniel Kolher made clear. With regard to the development of competing technologies, in particular the fiber-optic gyrometer, a member of the Sextant Avionique board stated that, in his opinion, "the PiXYZ represented the best optimization of the total package of features, performance, size, price for a long time to come."

Energy, Environment

Environmental Policies of Major Companies Surveyed

91AN0473 Groot-Bijgaarden DE STANDAARD in Dutch 21 Jun 91 p 21

[Article: "Half of Europe's Large Companies Have an Environmental Policy"]

[Text] Brussels—More than 80 percent of European businesses think that the demand for environmentally friendly products is growing, but only 55 percent of the largest companies have a formal or written environmental policy.

This was revealed by a survey undertaken by DRT. A questionnaire was sent to 250 major West and East European businesses in 15 sectors. Sweden showed itself to be the cleanest; all the concerns questioned stated that they had an official environmental policy, while in Turkey only 18 percent of the companies had one. More than half of the companies in Belgium, Denmark, the Netherlands, Norway, Italy, and Great Britain said that they had an environmental policy.

Of those questioned, more than 80 percent thought that the demand for "green" products is increasing, but only 45 percent have made changes in their production line. Ten percent felt that their company had lost business because consumers have turned away from products which are dangerous for the environment.

Germany: LISA Laser-Based Flue Gas Measurement System Developed

91P60240 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 29 Jul 91 p 10

Text] Scientists of the Institute for Physical Chemistry of the University of Heidelberg have developed a laser-based measurement procedure which could be applied for the protection of the environment. The LISA technique is conceived for purifying flue gases. LISA stands for in-situ laser-based ammonia monitor. It has been especially devised for reducing gaseous nitrogen components in flue gases.

By means of a sufficiently rapid mixture of reducing agents, such as ammonia or urea, within a specified range of temperatures, nitrogen oxide compounds can be reduced without an expensive catalytic converter. But, in order to prevent an overdose of the reducing agent, the drift of the ammonia must be determined as quickly and accurately as possible.

But, as stressed by the scientists, using conventional measurement techniques, massive problems arise during sampling. Moreover, the time resolution of the measurement is reportedly severely limited. Here, the LISA procedure is likely to help. The system was developed within the context of the Tecflam project of the universities of Heidelberg, Karlsruhe and Stuttgart, the Technical College of Darmstadt, the German Research Institute for Aviation and Space, and of the Konrad Zuse Center for Information Technology, with the support of various ministries.

[The procedure] makes possible contact-free measurement of ammonia concentration, directly in the flue gas channel. Here, there is no suction; rather, a spatial integration is carried out along the stream to be measured. The system has a detection threshold of only 1 part per million (ppm) and a response time of under a minute. Thus, application in on-line operation is also possible for automatic control of the addition of the reduction agent.

Ecological Reconstruction Program for Eastern Germany Discussed

91MI0406 Wuerzburg UMWELTMAGAZIN in German May 91 pp 140-141

[Text] "The current crisis in restructuring the economy in the new laender cannot be overcome with conventional economic instruments alone. What is really needed for a rapid economic upturn is an accelerated ecological clean-up." This is the view expressed by Federal Environment Minister Dr. Klaus Toepfer while presenting the "ecological reconstruction" campaign on 19 February this year.

The analysis of the state of the environment in the new laender that he commissioned last year, long before the two German states were unified, had already demonstrated that considerable environmental strain is caused by the perennially polluted sites. This applies primarily to the heavily industrialized south of the former GDR and for sites previously used by the former National People's Army and the Soviet Army. It was therefore necessary, said Minister Toepfer, to introduce immediate measures for 196 of the 12,250 perennially polluted sites identified to date and to investigate 248,000 hectares of suspicious military areas.

Ecological Reconstruction Program

The infrastructure needed to clean up these polluted sites would be created shortly as part of the "ecological reconstruction" campaign. Priority would be given to implementing the following measures:

- A world exhibition on reclamation technology to be held in the area comprising Halle and Leipzig, with innovative technology for all sectors of reclamation. The intention is primarily to set up six soil treatment centers, each with a 250 million German mark [DM] budget;
- Five thermal installations to be built for treating contaminated soil, each costing DM200 million;
- A chemical weapons disposal center, which the Bonn Environment Ministry calculates will cost about DM200 million;

As industry in the new laender currently has access to no special waste disposal facilities and still has to dump it, as before, on domestic garbage deposits or in the countryside or waterways, 10 special dumps at an estimated cost of about DM1.5 million each, plus two or three underground dumps at DM12 to 18 million each, are planned under the "ecological reconstruction" campaign.

The Federal Environment Ministry estimates that DM2 billion of the DM5 billion expected to be raised by a new tax will be spent to finance polluted site reclamation in the new laender. According to an agreement between the parties forming the Bonn government, this new tax will be levied on garbage.

What the reclamation of perennially polluted sites in the new laender will cost can be guessed from the figures

established by the IFO Institute of Economic Research in Munich. In a study carried out on behalf of the North Rhine-Westphalia ministries of the environment and the economy on the funds required to solve the most urgent environmental problems in the new federal laender, it concluded that some DM10.6 billion would be needed just for the initial work of hazard assessment and reclamation of the estimated 48,000 perennially polluted sites and suspicious areas.

Reclamation Target State Railways

The assessment of the perenially polluted site potential in the new laender has concentrated to date on the areas that arouse suspicion according to western German experience. However, a case reported by the Hamburg-based Technical Biological Applications company shows that the need for reclamation may well be much greater. The tanks of a diesel locomotive were damaged on State Railways land and some 2,500 liters of diesel oil were spilled onto the rails of a major trunk line. The material was not removed and taken to a waste dump because of the lengthy line closures that this would have entailed. So the State Railways and the environmental authorities concerned decided to have the contaminated area cleaned up on the spot.

For this purpose a detailed program of sampling and determining the extent of the contamination in terms of surface area and depth was undertaken. It was found that both the soil and substratum to a depth of two meters and the underlying goundwater had already been polluted by the spilled diesel oil. So the groundwater was included in the cleanup. In order to prevent the groundwater contamination from spreading, the Hamburg company sank two wells immediately after starting work, which are pumping out the polluted groundwater. The water is then cleaned in a three-stage installation and discharged into a nearby drainage channel.

The oil contamination in the railroad ballast is dissolved out with surface-active agents and treated with specially adapted bacteria.

It is expected to take six to eight months to reclaim this polluted site. The contamination has already been reduced by more than 50 percent in the first three months.

Germany To Ban Fluorocarbons by 1995

91MI0387 Wuerzburg UMWELTMAGAZIN in German May 91 p 17

[Text] With a few changes, the Bundesrat has approved the order banning CFC's [chlorofluorocarbons] and halogens adopted almost a year ago by the Federal Cabinet. This legislation will progressively ban the marketing, use, and to some extent also the production of halogenized substances, preparations, and products by 1995.

These substances contribute substantially to the destruction of the ozone layer. The ban will also help combat the green-house effect, in which CFC's and halogens also play a considerable part.

The Federal Republic of Germany will thus be the first country in the world to drop the use of fully-halogenized CFC's and halogens by the year 1995. It may then be designated practically "CFC-free."

The most important regulations will enter into force in the major areas of application as follows (see table below):

CFC (fully halogenized)	Banned from beginning of
as propellant gas in spray cans	1991
packaging material, foam tableware, canned foams	1991
coolants and refrigerants in large plants (except mobile plants)	1992
foams (except insulating, canned foams)	1992
cleansing agents and solvents	1992
coolants and refrigerants in large mobile plants	1994
coolants and refrigerants in small plants	1995
insulating materials	1995
R 22 AND METHYL CHLOROFORM (part-halogenized)	
as propellant gas in spray cans, packaging material, foam tableware	1991
canned foams	1993
methyl chloroform, cleansing agents, and solvents	2000
HALOGENS	
hand-held fire extinguishers, stationary fire fighting systems	1992
CARBON TETRACHLORIDE	
solvent	1992

The decision to include the part-halogenized CFC R22 in the order is of special significance. The Federal Government regards the continued use of part-halogenized CFC's as no long-term solution to the ozone problem. Federal Environment Minister Prof. Klaus Toepfer therefore expects German producers and users to be aware of their responsibilities and that part-halogenized CFC's will only be used in compliance with specific guidelines, as set out in the resolution passed by the Second Conference of States Party to the Montreal Protocol in June 1990. Here Toeper cited:

- use only where environment-friendlier alternatives or technologies are not available;
- use in a manner that will cause least harm to the ozone layer;
- emission control, recovery, and recycling systems to be applied wherever possible;
- collection and careful destruction following final usage.

German Company, DLR Develop Ceramic-Based Heat Accumulator

91MI0381 Bonn DIE WELT in German 30 May 91 p 19

[Text] Our energy requirements fluctuate considerably; at the end of the working day, for example, there is a demand

for power that would be very cheaply available at night. Remedying this situation would require energy storage units such as those currently being developed by the German Aerospace Research Institute (DLR) and Didier Works. The researchers are working on salt-ceramic-based high-temperature heat accumulators.

The economic viability of solar energy generation at our latitude depends decisively on whether superfluous heat can be successfully stored: On cloudy days, for example, it should be possible to call on reserves of unused heat. Similar problems exist in the glass and steel industries. The hot exhaust gas from combustion processes is too dirty to be used to melt glass, for example, so it is diverted through a ceramic heat accumulator, which is heated up by the exhaust gas then gives the heat off into a clean air flow, from 12 to 24 times a day. For this reason, industrial ceramic accumulators are designed primarily as efficient heat exchangers rather than as optimum stores: Tubular or honeycomb structures provide a large exchange surface, whereas this high surface to volume ratio militates against effective storage.

In comparison, a store in a solar power station is only discharged once a day on average, so the energy density must be considerably higher. There are also differences in temperature and pressure. Operating pressure in excess of 10 bar is needed to raise the energy density in air as the exchange medium. If the stored heat is used to generate electricity via steam or gas turbines, the output temperature must also be between 500 and 1,000 degrees Celsius.

One solution is offered by latent heat storage in a hybrid salt- ceramic material. A salt melt stores the energy fed into it, which it discharges again when it solidifies. These accumulators are already familiar in the low-temperature field, where the heat- storing salt is separated from the transport medium by a ceramic structure that acts as the heat exchanger. But this design presents the drawback that heat exchange on the solid surface gives rise to cold areas on the wall where the melt solidifies, forming an insulating layer of solid material.

There is now a new design based on a porous matrix of oxide ceramic filled with the latent storage material. As in a sponge, small cavities soak up the liquid salt and hold it fast by capillary action and surface tension. Thermal energy can now be exchanged by direct contact between the salt and the cross-current of air. Didier Works, which is one of Germany's largest ceramics producers, joined the development work funded by the Federal Ministry of Research and Technology (BMFT) in 1988.

DLR laboratory experiments have considerably increased storage density as a function of the temperature difference in the material between charging and discharging. If the difference exceeds 500 degrees, a cascade of materials with different melting points must be set up. Tests on the practical feasibility of the process are scheduled to start next fall in a test station in the DLR's grounds near Stuttgart. By then, Didier intends to prepare two tonnes of material for the accumulator, which will work at a broad range of temperatures and pressures. Exhaust gas entry temperatures of 700 degrees and output temperatures of 1,300 degrees Celsius should be possible.

Germany: Increased Process Heat Network Efficiency in Sight

Surfactants Reduce Friction

91MI0366A Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 17 May 91 p 11

[Text] Public support for long-distance heating has grown over the past few years, as it is both environment-friendly and energy-saving. As the heat transfer medium used is hot water flowing through long pipelines, any flow loss resulting from friction and turbulence reduces energy transmission. The viscosity of the water used as the heat transfer medium can be reduced by adding surfactants as antifriction agents. This reduces loss due to friction against the pipe wall and in the water itself.

Since the early eighties, the BMFT [Federal Ministry of Research and Technology] has been funding a 5.4 million German mark joint project that has been investigating the practical problems involved in using these additives in long-distance heating networks. The final report on the project has just been submitted. The universities of Dortmund and Hannover, Fernwaerme-Verbund [Long-Distance Heating Consortium] GmbH in Voelklingen, and the Frankfurt-based DECHEMA [German Chemical Apparatus Company] are the participants.

Laboratory tests have shown that friction can be reduced by an average of 60 percent, thus raising throughput by 25 percent, in long-distance heating, given the same electrical pumping capacity. This will improve the efficiency of existing long-distance heating networks, and either raise the number of end-users that can be connected to long-distance pipelines of the same diameter or reduce the electrical power consumed by the circulation pumps. The result is a saving in energy.

The laboratory results were tested on a large scale as part of two EC demonstration projects, which also involve the performance of long-term tests in 1991. These tests are designed to demonstrate the economic and technical viability of antifriction agents for use in long-distance heating systems.

The work involved in this joint project has been and is being supported by close cooperation among long-distance heating operators, producers of long-distance heating equipment and antifriction agents, research institutes, the Long-Distance Heating Association (AGFW), the International Energy Agency (IEA), and the EC Commission.

This merging of different lobbies and institutes ensures a rapid transition from laboratory tests to long-distance heating practice. Practical problems are identified at an early stage, so laboratory research can be adapted to requirements as soon and as well as possible.

Additional information may be obtained from: Institute of Thermal Process Engineering at the University of Dortmund, Emil-Figge-Strasse, 4600 Dortmund 50, tel. 0231/755-2323.

Diatomaceous Earth Improves Insulation

91MI0366B Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 17 May 91 p 12

Reseachers seeking environment-compatible alternatives to polyurethane, an insulating material with a high CFC [chlorofluorocarbon] content, have come across diatomaceous earth, a mineral powder available in large quantities, easily degradable, and potentially capable of reducing heat loss by 75 percent. Since October 1990, the Berlin Power and Light Corporation (BEWAG) has been usng a pilot plant to test a new pipe system for long-distance heat distribution involving vacuum superinsulation (VSI) with diatomaceous earth.

The VSI research project in Berlin is one of nine individual projects studying and developing new heat insulating systems and funded by the Federal Ministry of Research and Technology (BMFT). Besides BEWAG, the participants are pipe producer Mannesmann Seifert GmbH and the Technical University of Berlin. In the grounds of the Reuter-West heating and power station, which hosts the experimental plant, 96 meters of VSI pipes have been laid above ground and 96 meters under ground. The pipes are connected to a BEWAG hot water transport pipe.

Heat loss in long-distance heat distribution with VSI pipes is 75 percent lower than with the pipe systems used to date. With heat insulation 100 mm thick and at a temperature of 120°C, the specific heat loss is 20 W/m. The reduced transmission loss could render the supply of heat to users over longer distances economically viable.

Diatomaceous earth insulation was originally developed for space applications. The insulating properties of diatomaceous earth have been known since the beginning of the century. It is a fine-grained, heat-resistant powder consisting of the remains of fossilized crustaceans. It is quite widespread and easily degradable. Manufacturing, material, and assembly costs are thus low. The Berlin project has a two-year schedule and is costing 4 million German marks. The BMFT believes that future VSI applications could also include smaller systems, such as domestic storage heaters, coolers, freezers, and industrial cold storage containers and stores.

Germany: Renewable Energy Developments Reviewed

Sensors For Solar Collectors

91MI0340A Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 17 Apr 91 pp 4-5

[Text] A high collection factor, which in turn gives a high degree of efficiency in solar collectors, is guaranteed when the solar collectors track the sun's daily path as accurately as possible. For this reason, the Juelich Research Center has developed an optoelectronic sensor for solar plants. The sun is tracked in two axes via adjustable DC motors, triggered by the signals from the sensor. Applications and characterictics are the measurement of optical deviation and readjustment with accuracy superior to 0.02 degrees (0.3 millirad), adjustable sensitivity of approximately 100 watts per square meter solar radiation, a response time of less than 0.1 seconds, and an aperture angle of plus 0.75 percent. The sensor can be used for tracking with parabolic or spherical concentrators, in heliostats (fields), in test equipment for solar high temperature generation, for variance comparisons with computer-controlled solar plants, and in general to measure the angular deviation of a distant light source and to track moving light sources (e.g., navigation).

Q Particles For Solar Cells

91MI0340B Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 17 Apr 91 p 5

[Text] The Hahn Meitner Institute (HMI) in Berlin presented several solar energy research topics at the Hannover industrial fair. The HMI recently performed the first experiment to produce a solar cell with what are known as Q particles. A degree of efficiency of between 2 and 3 percent in the conversion of sunlight into electrical energy has already been achieved in these initial tests with this type of cell.

Q particles represent a new state of matter. The study of their properties is still pure basic research. It is still not clear to what extent technical exploitation of these particles, for example in solar energy, will ever be feasible. Several years ago it was discovered that a particular quantum-mechanical effect occurs in semiconductor particles, which have a diameter of only a few nanometers (one nm = one millionth of a millimeter), in the Q particles, to be precise. The positive and negative charge carriers ("holes" and electrons) released as a result of light absorption in this extremely thin semiconductor "detect" the extreme spatial limitation in the particles.

With Q particles, as opposed to compact material, only a fraction of the amount of matter is required to absorb all incidental sunlight.

The energy-band gap, which is a material-specific value in compact semiconductors, is variable in Q particles and is largely determined by the particle size. To build efficient solar cells, the energy-band gap of the semiconductor materials used must match the spectral distribution of the sunlight. This is where Q particles, with their variable energy-band gap, offer novel and interesting possibilities.

Thin-Film Technology Solar Cells

91MI0340C Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 17 Apr 91 p 6

[Text] The production of cheap, low-material solar cells demands semiconductor materials capable of absorbing incidental sunlight in a very thin film. A material widely

?used to produce thin-film solar cells is amorphous silicon, which, however, has the decisive drawback that the solar cells decompose in time owing to exposure to sunlight.

The Hahn Meitner Institute in Berlin has achieved 8-percent efficiency with a thin-film solar cell consisting of polycrystalline copper indium disulfide.

This compound has the advantage that it dispenses with the poisonous element selenium, which is used, for example, in copper indium diselenide, the alternative to conventional silicon. However, the rare element indium must be used.

Water-, Windmill Exploitation

91MI0340D Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 17 Apr 91 p 6

[Text] Germany has more than 4,000 wind- and water mills, some still with their sails or water wheels intact. Water rights or nostalgia are often the reason for maintaining these mills, but that need not be the only reason. In fact, these plants are worth fitting with electric generators.

Prof. Bert Kueppers of the Electrical Engineering Department at Aachen Technical College has developed a new type of control unit that works in conjunction with a threephase asynchronous generator and can be installed anywhere where a constant voltage and frequency network (220-280V/50Hz) is required independant of the public grid. Compared with conventional systems, this solution is considerably cheaper, avoids the usual control fluctuations, and offers an opportunity to use alternative energy.

Wind Power Project

91MI0340E Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 17 Apr 91 pp 6-7

"Use renewable energy sources" is the motto of the day. Studies carried out under the interdisciplinary project on "technical, economic, and legal aspects of the operation and exploitation of wind power plants" under way at Muenster Technical College (Electrical Engineering: Prof. Horst Buhrmester; Economics: Prof. Friedrich Keun) show that wind power too provides an interesting alternative. The project examines questions of technical feasibility, acceptance, visual impact, and accoustic effects. The project illustrates how small and medium-sized enterprises can use wind power, integrate wind power plants into the existing power supply network, and measure and economically exploit wind power. The findings of the study will appear shortly in handbook form.

German Aerospace Institute Develops UV-Sensitive Biofilm

91MI0305 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 3 Apr 91 pp 6-7

[Text] In order to simplify the series of measurements required to ascertain the connection between the ozone hole and UV radiation, the Biophysics Department at the German Aerospace Research Institute (DLR) has developed a new type of biofilm that offers many advantages:

- The measurement procedure and evalution of the results could hardly be simpler;
- The film is cheap to produce, and
- The measurement apparatus fits into an ordinary briefcase.

Reduced ozone concentration leads to increased UVB radiation in sunlight. In turn, UVB radiation damages cells and triggers mutation, causing skin cancer, for example. For some time researchers have been trying to prove that there is a relationship between the reduction in the ozone layer and the amount of cell damage due to UVB radiation.

The biofilm functions rather like a photographic film. A commercially available substrate foil is coated with an emulsion containing spores of the Bacillus subtilis bacteria. These spores are UV light-sensitive, but can be stored very well in darkness.

Evaluating the spore damage caused by radiation is just like developing a film. After exposure for one year in the Antarctic, where the ozone hole is particularly large, the biofilm is placed in a growth medium. The spores germinate and create biomass, especially protein. When the growth phase is over, the protein formed can be revealed by staining. This results in heavily or lightly colored areas, according to the degree of UV radiation. Heavily colored areas are those that have created a large amount of protein, and were therefore exposed to weaker UV radiation, whereas lightly colored areas received a high dose of UVB.

Different light wavelengths affect biological systems with different degrees of intensity. For example, UVB radiation causes cell damage, UVA tans the skin, and long-wave, i.e., infrared, radiation imparts warmth. Failure of the bacteria in the emulsion to germinate must be attributed primarily to UVB radiation. However, in order to give complete certainty that the cell damage is caused exclusively by UVB radiation, the biofilm is also shielded by filters that absorb all other wavlengths.

The newly developed biofilm, patented by the DLR, represents a considerable improvement on previous processes, especially in the evaluation phase. Before, a large number of different types of spores had to be exposed to UV radiation in an expensive apparatus for various periods of time. The spores were then placed in a nutrient medium to germinate. This produced thousands of bacteria colonies that had to be counted—a very difficult and time-consuming process.

FACTORY AUTOMATION, ROBOTICS

Germany: Robot-Operated Ultrasonic Welding Technique Developed

91MI0395 Bonn TECHNOLOGIE NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 28 May 91 pp 5-6

[Text] Ultrasonic welding is gaining ground for bonding plastic parts. In ultrasonic welding, the two pieces to be bonded are positioned between a sonotrode vibrating at ultrasonic frequency and a thrust block, then pressed

together with a defined force. During the welding process, the components are heated locally by mechanical vibrations. After a brief cooling period, the result is a welded joint of high strength. The process has been used to date in stationary welding presses or with simple hand-held pistols, but the automobile and other industries are now considering introducing ultrasonic welding in a more flexible, automated form. The ever- increasing demand for greater flexibility calls for the use of an industrial robot.

To meet these demands, a robot-compatible ultrasonic welding tool has been developed a the Fraunhofer Institute of Manufacturing Engineering and Automation (IPA).

This patented tool is basically an ultrasonic welding system consisting of a converter, booster, sonotrode, and welding tip, mounted on a linear carriage with a pneumatic feed unit. According to requirements, a tailstock can be added to provide welding tongs with closed power flux. If the application so requires, the configuration can accomodate additional peripherals, for example feed systems for small parts and sensor systems for quality control.

In the new process, the robot positions the tool at the bonding point, the jaws of the tongs are closed at a defined force, and the welding process begins. After the first welding cycle, the robot can perform further positioning and welding sequences or place the tool in store.

Various types of welding tip can be used to adapt the tool for spot- welding, riveting, beading, sheet welding [Bahnschweissen], wing surface welding, and metal part embedding. The process is also being used successfully for ferrous materials, nonferrous metals, glass, concrete and combinations of materials as well as for plastic components. Its wide range of applications and short cycle times guarantee cost-effective use and maximum flexibility.

Further information can be obtained from: Fraunhofer Institute of Manufacturing Engineering and Automation, Mr. H. Grosser M.A., Nobelstr. 12, D-O-7000 Stuttgart 80, reference Ultrasonic Welding (reference number 6).

Germany: BMFT Robotics Program Researches 3-D Laser Welding Tasks

91WS0380a Landsberg PRODUKTION in German 25 Apr 91 p 9

[Article by Holger Knots and Udo Wolff, Engineers and Scientists at the Fraunhofer Institute for Laser Technology, Aachen (Prof. Dr. Gerd Herziger): "Robot Guides Laser Beam—Motion Studies with Industrial Robots Using Passive Beam Guidance"]

[Text] Aachen. After the successful integration of laser technology into planar, two-dimensional welding and cutting applications, lasers are now being used increasingly for 3-D materials processing as well. Examples include automobile manufacturing, in particular body and chassis manufacturing.

Generally, CO_2-laser beam sources with high outputs of up to 5 kW are used. Beam guiding systems which deflect the beam via mirrors having a special coating to reduce absorption direct this output to the processing optics with as little loss as possible while ensuring a high beam quality. For manipulating the beam at the workpiece special cartesian linear-axis machines with their own integrated beam guidance system are the obvious solution. However, as an alternative solution various passive beam guidance systems have been under development for some time with the objective of utilizing the well-known advantages of 6-axis industrial robots for this new technology. These advantages are flexibility and adaptability to various processing tasks as well as excellent movability where access is limited. In addition, industrial robots have been used successfully for arc path welding and bonding applications.

The advantage of materials processing using a laser beam, i.e., markedly higher processing speeds due to increased processing density, also presents specific problems when dealing with industrial robots. Three-dimensional tasks are characterized by a changing radius of curvature along the path. When programming the machine, this changing radius has to be approximated using progression. Points of discontinuity, i.e. corners, which can be described by a minute radius of curvature, require the industrial robot to perform a multiaxis compensating movement. Due to the design of the beam guidance system and the shape of the beam (focal distance of the focussing optics) these reorientation movements require high speeds and rapid acceleration of the axis to be moved. The geometrical dimensions of the beam guidance system and the deflecting mirrors cannot be reduced since they are determined by the beam diameter.

As part of a combined BMFT-sponsored project called "3-D Processing with High-Performance CO_2-Lasers" the motion of a number of different articulated arm robots was studied and compared with those of a CNC controlled, cartesian robot.

Determination of path accuracy requires the selection of suitable measurement principles:

- Marking on a measurement normal using a mechanical tracer
- High-speed video camera

At the Institute for Laser Technology (ILT), the focussed pilot laser is coaxially mirrored into the beam path of the processing laser and its motion is recorded on a measuring grid. This allows a high path accuracy resolution depending on the focal distance of the camera optics.

- Infrared Dual Camera System

(for stereometric measurements):

This system is used to record free translatorial and rotary measurements in the 3-D workspace. The fixed-position cameras with overlapping viewing areas photograph a light source (LED) which is attached to the tool (processing optics). The workspace in which the LED motion is photographed is defined by calibration of the complete system prior to the measurement. A computer connected to the cameras analyzes this motion with regard to path accuracy, speed and acceleration. Disadvantages of this

system are time-consuming picture analysis, camera sensitivity to reflected interfering radiation and the extremely precise calibration required. Another source of error is a directional characteristic in the LED beam emitted. The rotation between the main beam direction and the focal plane of the camera which is superimposed onto the linear LED movement in the workspace can lead to incorrect calculation of the actual position.

- 4-Sensor Angle Hand:

Due to the 90 degree offset of the sensor pairs a lateral deviation from the target path along any 3-D path normal can be measured. Because of the additional sensor arrangement in pairs the measurement is increased by the three degrees of freedom of the distortion. The geometry of the path normal and the maximum values of the path deviations to be recorded are determined by the measurement range, the resolution and the nominal sensor distance. The minimum radius of curvature of the path is preset by the sensor size and the minimum sensor gap which is a function of the sensor size. A PC retrofitted with a multifunction card is used to analyze and process the signals.

- Path Measurement by Laser Interferometry:

The tool to be moved is equipped with a retroreflector and hit by one or several measurement lasers. The reflected beams are recorded by sensor units which are equipped with active, position-controlled actuators and which automatically track the retroreflector movement. The instantaneous position of the tool in the cartesian workspace is calculated from the current position of the tracking units and the sensor gap which is measured by laser interferometry. Because of the limitations and disadvantages of the various principles the number of movements that can be studied simultaneously has to be reduced. Classifications of various movement sequences for the comparative study of movements can be found in the literature. The use of standardized movement sequences allows a comparison of various handling systems. Along with the study, various 3-D tasks were carried out by laser and by the handling systems presented here. By comparing the results it was possible to show the suitability of industrial robots for specific applications. Optimum handling of a manufacturing task requires knowledge of the movements of the specific handling machine. In addition, the system programmer must be thoroughly familiar both with the industrial robot and with laser technology. Therefore, indiscriminate use of CAP technologies will not yield high-quality processing results in the near future. Automatic compensation of path deviation using special tracking systems (currently being developed at ILT) will both shorten programming times and improve the processing results.

Germany: Increased Role for Simulation in Factory Automation Planning

91WS0393A Landsberg PRODUKTION in German 2 May 91 p 3

[Article: "Test Runs for Production: Simulation As an Indispensable Tool of the Production Engineer"; first paragraph is PRODUKTION introduction]

[Text] Dusseldorf (ra)—The planning of complex, flexible manufacturing systems calls for efficient methods and tools. Simulation, still often suffering from the aura of the exotic in Germany, is going to change radically the production engineer's job in firms.

Tools must be practicable and cost-efficient. This was not the case for simulators until the middle of the 80's. Simulation required specialists who could use complex programming languages. Mostly runnable only on mainframes, simulation remained restricted largely to the domain of science and big business. For instance, manned space flights would hardly have been possible without simulation beforehand. Technological pioneers like the aviation and automotive industries also made use early on of the digital illusion of flight, traffic and crash simulators.

Only when efficient microcomputers with enhanced graphics capabilities became available did simulation become accessible to a broader range of users. Software for the most different but often only limited applications came on the market. Because the demand was there. The growing complexity of flexible manufacturing systems, shorter product cycles and heightened investment requirements have the production engineer confronting the limits of analytical planning methods. Integrated planning and a systems approach are required instead of the optimization of individual areas.

With simulation the production engineer has an efficient tool at his disposal for the representation of internal relationships of systems, for the investigation of the time-dynamic behavior of a system and for the verification of designs before a system is implemented. In addition, new strategies can be tested without interfering with running processes, and options can be played out more quickly and cost-effectively than on the real subject. The following are considered today general requirements for a practicable simulation tool: a comfortable user interface, interactive operation and animated color graphics in real time.

"In spite of all that," in the words of Graduate Engineer Klaus Harder, managing director of Istel's German branch, in the course of the "Innovative Approaches Via Simulation" symposium, "simulation as a planning tool is still catching on slowly in Germany. It is otherwise in the Anglo-American realm, where the 'See Why' software package, that came in already in 1979 as the first animated color graphics, and its further development 'Witness' have been able to pocket innovation awards several times already."

"Witness" was developed with the aim of making simulation as a planning tool accessible to a broad range of users in industry. The hardware requirements are an AT-compatible personal computer or an IBM PS/2. As an interactive visual simulation system it is designed especially for the construction of production models. The user uses supplied model modules and functions without having to be concerned about the internal representation and implementation. Animated color graphics provide for a dynamic general survey of simulated systems and flows,

so that it is also possible for specialists with a knowledge of programming to interpret the results.

Professor and Doctor of Engineering Axel Kuhn of the Fraunhofer Institute for Material Flow and Logistics characterized the reservations still prevalent in Germany against the introduction of simulation into logistics as to some extent well founded, although as not justifiable from his point of view. He named as the most frequent objections: uncertain databases because of vague defaults, poorly thought-out control rules, nonexistent fault data, and often only forecast job data. The cost will also often be criticised by the user: It takes too long, is too expensive and is not flexible enough in the application. He classes under the third group of skeptics the rule-of-thumb experienced people who already know roughly what the result will be before each simulation.

On the other hand, Kuhn emphasized the important advances in simulation and pleaded for planning-assisting simulation. Often in practice simulation will be called in only if the production engineer knows no more. A simulation model must be regarded from the outset as a component of a planning process and—used optimally—accompany the entire life cycle of a system. At VW simulation work is done before every major investment, and as a result 100 million German marks [DM] have been able to be saved to date. Another automobile manufacturer discovered by looking at simulation studies that had been prepared that around two percent of the investment sum can be saved as a result of simulation.

Negligible Modularity Is Still a Shortcoming

Finally, Kuhn set forth a number of shortcomings of today's simulators, whereby he at the same time characterized the target trend of future development work. The application orientation and graphic support have to be improved. The negligible modularity of the software structure and model universe is regarded as a shortcoming of today's systems equally with the limited model universe and level of detail. In the future a simulator will also have to be able to form equally images of data streams and object streams. Not least, it is necessary to integrate simulators into a firm's computer facilities in order to have the use of integrated tools. Interfaces to external databases and programs (database, CAD [computer-aided design] and PPC [production planning and control]) are lacking to date. Intensive work is to be done on these problems.

Kuhn, who also heads the "Simulation in Manufacturing Engineering" study group within ASIM—the simulation study group of the Society for Computer Science, is convinced that simulation will be the preeminent planning tool of the 90's.

Dealing with simulation is becoming easier and the demand is growing out of proportion. The market is reacting accordingly. With the multitude of simulators being offered, that cost between DM5000 and DM150,000, the potential user's problems begin already with the selection. While big businesses as a rule set up their own simulation teams, firms in the middle class face the question of "Make or Buy." Consultants are offering their services here.

Graduate engineer Rainer Debus of the Rüsselsheimer GM subsidiary EDS commented on several service variants in the field of the application of simulation that range from applications consulting, through training to implementation. The "Make or Buy" decision should be made on the basis of a scope-covering requirements analysis that is made within the framework of a pilot project by a consultant. If the management decides on its own simulation team, this team can be trained on the job to be simulation experts by an outside specialist.

If simulation tasks do not turn up steadily in a firm, it is as a rule wiser and less expensive to engage an outside consultant case by case. Management can decide from its experiences in the pilot study conducted where and when it is wise to use simulation and react accordingly in good time.

The question of the wise use of simulation was settled long ago for Graduate Engineer Johannes Wortmann, head of production engineering and control at Karmann in Osnabrück. In the firm's toolmaking and machinery building operations, new production units both for in-house vehicle types and for outside automotive industry customers are designed and manufactured by means of computer-aided systems. The planning and development of such a CIM [computer-integrated manufacturing]-capable factory with scope-covering manufacturing sections has become exacting to such an extent that production engineers must of necessity use new working methods. So it was just a logical step for Karmann to introduce computer-based simulation as a supporting and companion tool for planning. The factory planners in Osnabrück have been working for a good three years with the "See Why/Witness" software package from Istel. The fact that it is runnable on a single PC and that trained employees could develop practice-oriented approaches with it was decisive for the system's selection. It is not necessary also to pay for additional simulation experts with this system. Nevertheless, Wortmann cautions against underrating the planning team's engineering contributions leading up to simulation. "It has become apparent," Wortmann says, "that the precision of the input data as well as the effort put into preliminary planning dictate the quality of the simulation results."

Simulation Improves Quality Considerably

At Karmann the quality of planning has improved considerably as a result of simulation. However, it became clear to the engineers as early as during their first simulations that the technical simulation of several variants of an on-line economic calculation had to be assisted. Such an integrated simulation program for economic computations is now under development in collaboration with Osnabrück University. Because, says Johannes Wortmann, "The best technical approach guaranteed to make sense by simulation is of no help if it is not cost-effective."

Germany: APERIA-PPS/L Production Planning, Control System Described

91WS0338A Berlin FERTIGUNGSTECHNIK UND BETRIEB in German Apr 91 pp 204-207

[Article by K.M. Schluh, graduate engineer, and K. Fagenzer, graduate mathematician, Aperia Software GmbH [Ltd.] + Co KG [limited partnership], Bad Nauheim: "APERIA-PPS/L Production Planning and Control System With Integrated Expert System: a Promising Approach for Universal CIM and CIL [Computer-Integrated Logistics] Concepts"; first paragraph is FERTIGUNGSTECHNIK UND BETRIEB introduction]

[Text] There is an almost bewilderingly large number of PPC [production planning and control] systems for sale today. However, if they are judged by the proper methods, then it is often difficult to find anything new there. Expert systems that would be able to support the complex tasks and functions in production planning and control have thus far hardly been introduced into PPC systems. For this reason, the approach presented is an interesting example of how logistics-oriented approaches to PPC designs can be made "intelligent" and "user-friendly" by the use of expert systems.

0. Introduction

Up-to-date logistics and CIM concepts can be implemented with traditional PPC systems only poorly, even with radical reorganization measures. Rapidly changing market situations are resulting in a growing multiplicity of versions, increasing volumes of data, shorter delivery times, shorter product lives, growing product complexity and higher standards for the quality and consistency of products.

In order to be able to fulfill these requirements, highly skilled employees in manufacturing industry firms in all fields involved in order filling are being saddled more and more heavily and often constitute the bottleneck in the solution of customer problems. The knowledge of experts in the fields—sales, technical support, design and development, process control, assembly, quality assurance and shipping, as well as in warehousing and transportation—even with the use of PPC systems, is available only to a small extent as solid support for the fields and functions named. Expert knowledge is available as solid support for many operating functions only with the integration of knowledge-based systems (expert systems) into PPC systems.

The expert system as an integrated component of a PPC system places at one's disposal the factual and professional knowledge of experts with the pertinent problem-solving mechanisms for all areas and functions of production planning and control. Here the expert system contains the knowledge that is available for solving problems and predetermines the manner it which it is used.

The fields of application of expert systems for production planning and control are numerous. In combination with relational databases and software layer models along the lines of an open-ended system, an expert-system-supported PPC system offers optimal capabilities for current and prospective logistics and CIM design approaches. The "simultaneous planning" of all resources in real time can be implemented with such a PPC system, just as much as the automatic configuration of variants in variant processing.

The integration of an expert system has been implemented for the first time in the PPS/L [production planning and control/logistics] system developed by Aperia Software GmbH in Bad Nauheim for industrial application in IBM mainframes. Porting to additional computers like the IBM-AS 400, PC-AT 386, UNIX, and DEC-VAX is being effected at present with the Aperia OSSY development tool through Aperia Software GmbH.

1. Solution of the Variants Problem by Means of the APERIA-PPS/L

The trend-setting design concept reveals developments and trends for prospective PPC developments toward the broadening of logistics and CIM concepts and is exemplified more specifically by the example of an approach implemented in a variant processor in the kitchen furniture industry.

The following basic situation is typical of these variant processors. They are characterized by the following:

- An enormous variety of parts and types
- High frequency of modifications of customers' orders
- Fluctuating demand
- No warehousing of finished products
- Deadlines precise to the day for scheduling and delivery

Add to this the fact that the number of kitchen programs and types, and with that the product variance, have become substantial because of market demand. In the product description in the parts list, one encounters the limits, with regard to data management and transparency, of the system instituted up to the present.

The volume of data is formidable. It is a matter of dealing with about 4000 item families, 70,000 part families and over 270,000 product structures.

The solution to this problem is based on architectural principles of expert systems completely integrated into the conventional PPC application environment.

Besides, configuration application knowledge is stored in an as easily as possible expandable form. The system is then able to process this knowledge directly by means of an interference mechanism. The following is important in this connection: Processing rules and data specification remain easy to grasp for the user. The user can on his own and without great cost implement his own configuration algorithms and functions in the software system.

1.1. Expert-System-Supported Primary Data Management

As usual, production data such as the part family, parts list, production schedule and operating materials form the basis of a functioning production planning and control system.

The business's logistical objective is the synchronization of material flow and information flow. The prerequisite for this is to organize production in manageable control loops and to map all production data in accordance with the material flow. In this case the manufacturing schedule determines the logical structure of the production data as well as the logic of the planning and control tools.

Within the production data, the parts list is the link between product (sales) and production for the kitchen furniture manufacturer. It describes which components a finished product consists of. At the same time it is the basis for material management, scheduling, production and purchasing functions.

Conclusion: A flexible parts list drawn up in accordance with the material flow and manufacturing schedule ensures transparency and continuity. It controls central management of the operation. Complete integration is achieved by means of the following:

- Forming constant parts lists in the form of part families and design-and-manufacturing engineering criteria
- A variant expression methodology
- Storing variant parts as a part family
- Dynamically generating variants during decomposition of a parts list
- Storing the required capacities and operating materials in the parts list in the form of a production plan for the simultaneous planning of all resources (static mapping), control and execution (dynamic map) of management, fabrication and assembly.

The expert-system-supported APERIA-PPS/L system (fig 1) touches down on these basic requirements. The central concepts are expounded below for a better understanding of further specifications:

- Variants: customized embodiment of products
- Variant type: specification expressions, like color, type or handle, carcasses, etc.
- Variant report group: variant type depending on part family
- Variant code: conveys the significance of variant types through a code or the direct value
- Variant expression: customized expression of the variant report group (combination of several variants)

1.2. Constant Parts Lists and Part Families

The part family is the central concept for the parts list map. The part family is a set of parts that are similar with respect to design/fabrication technology. The structural designs of each article (part) within a part family are identical. Differences are manifested just in the specifications of components (color, quality), in dimensions and/or in the type of fabrication.

For example, all wall cabinets consist of a carcass and a door or a shutter. Carcasses for wall cabinets are made out of side panels, bases (upper and lower) and a rear wall, and the door/shutter out of a door leaf and button or handle. The set of components is assigned to the particular part family.

1.3. Variant Report Group/Variant Expression

A variant report group is assigned to each part family. The variant report group is a combination, valid for the part family, of variant types and variant codes. The selection of matching components or assemblies, respectively, is a result of the variant expression. The variant expression table consists of:

- Part family
- Expression number
- Variant report group
- Existing part numbers as a link to the part family set in the existing old system

Important criterion: The variant expression table is logically a supplement to the part family tree and not to the parts list.

2. Example of An Expert-System-Supported Variant Configuration

The variant problem will be demonstrated, and the solution of the problem by means of the rule-based variant parts list will become clear, in the example of the simple piece of furniture, a table.

A table always consists, regardless of its dimensions, style and its color, of a tabletop and four legs. It has only two components, regardless of the variations of the table's constant parts list modules.

This simple structure becomes complex even if the constructional correlation of the variants of the table and of the variants of its components is to be mapped. That is to say, in the worst case a separate set of modules has to be made for each variant. Or a variant- selection set of modules will be used that contains at the same time all components of the possible table variants.

In the latter case, a variant-selection set of modules having 10 x 10 x 10 tabletop variants and 10 x 10 leg variants, i.e., having 1100 sets of components in the set of modules, has to be constructed in the practice of often encountered procedures in conventional PPC systems for the really simple table having, for example, 10 dimensional variants, 10 styles and 10 colors.

With the rule-based variant parts list in the PPS/L system the variant correlation in the constant parts list is represented in plaintext via a few rules. The quantitative inflation pointed out in the parts list is avoided in this case. The noteworthy result—illustrated in the example of

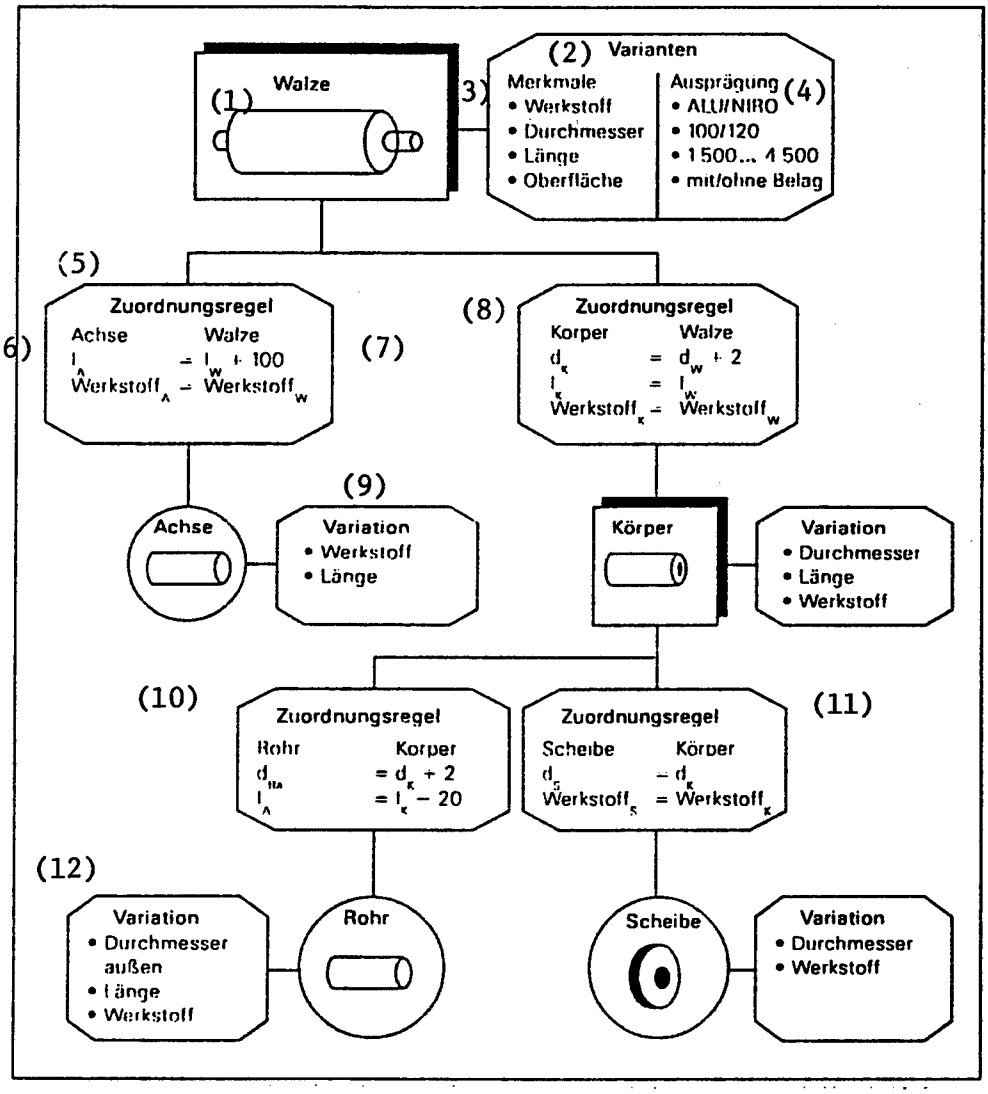


Figure 1. APERIA-PPS/L with integrated expert system for the configuration of variants

Key:—1. Roller—2. Variants—3. Specifications: material, diameter, length, surface area—4. Expression: ALU/NIRO, 100/120, 1500 to 4500, with/without covering—5. Assignment rule—6. Axle—7. Roller—8. Body—9. Variation: material, length—10. Pipe—11. Washer—12. Variation: outside diameter, length, material

the table—is that only two rule-based structure records are enough in order to replace the 1100 conventional structure records (fig 2).

Variant Master Data Approach Via PPS/L

The rule-based variant parts list for the table, then, consists of the three nodes "table", "tabletop" and "legs" of the constant parts list, of their respectively assigned variation features and of the two assignment rules, i,e., of exactly eight elements.

Each node of the constant parts list for the table, i.e., "table", "tabletop" and "legs", gets assigned the features in which it can vary.

They are for the table (T) the features: T-dimensions, T-style and T- color. The tabletop (P) can vary in the features: P-dimensions, P- style and P-color, whereas the legs (B) can possess only the features: B-style and B-color. It is defined by the linking rules from table to tabletop that

- The dimensions of the tabletop = P-dimensions are set equal to the dimensions of the desired table, the T-dimensions.
- The style of the tabletop = P-style is set equal to the style of the desired table, the T-style.
- The color of the tabletop = P-color is set equal to color <169> of the desired table, or T-color <170>.

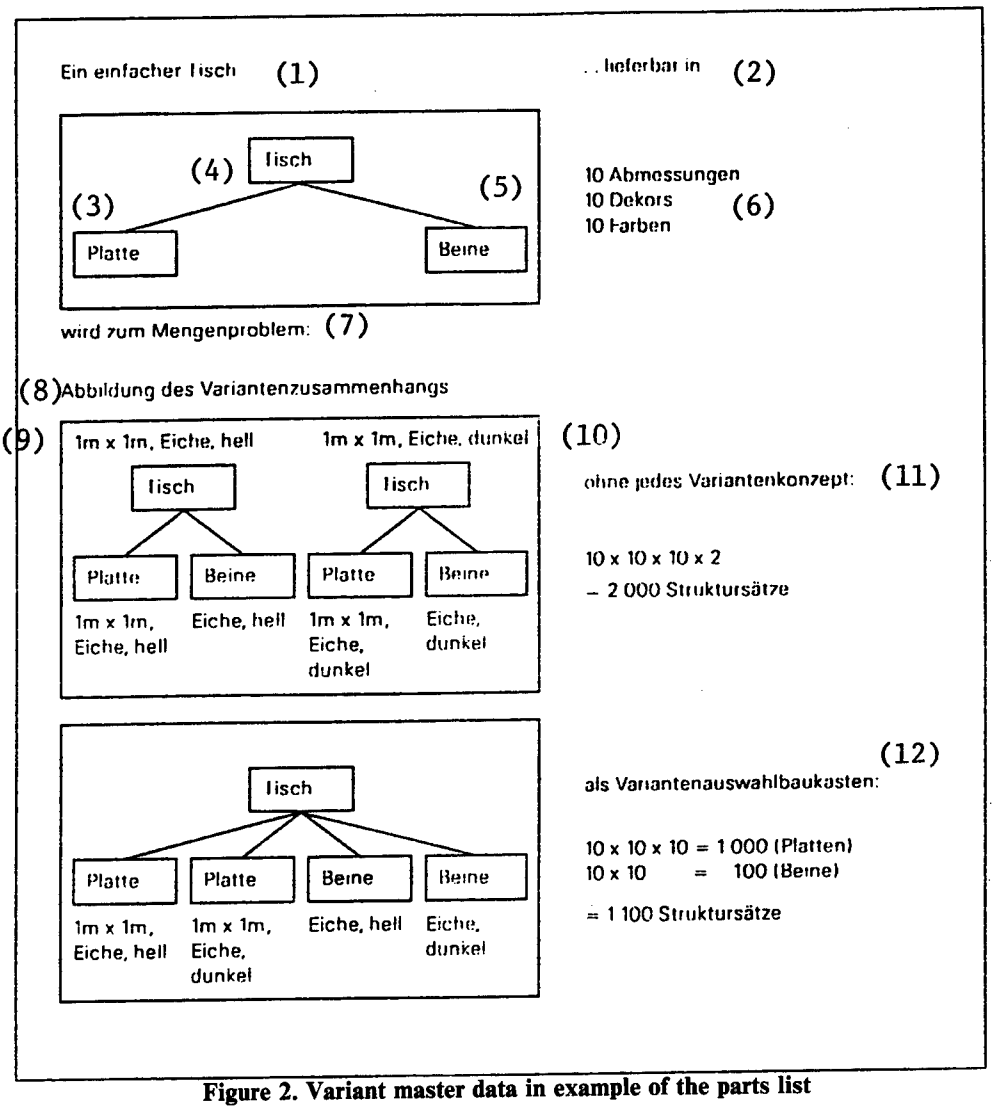


Figure 2. Variant master data in example of the parts list

Key:—1. A simple table—2. Deliverable in—3. Top—4. Table—5. Legs—6. 10 sizes, 10 styles, 10 colors—7. Will for the set problem:—8. Mapping of variant correlation—9. 1 m x 1 m, oak, light—10. 1 m x 1m, oak, dark—11. without any variant concept: 10 x 10 x 2 = 2000 structure records—12. As variant-selection set of modules: 10 x 10 x 10 = 1000 (tops), 10 x 10 = 100 (legs), = 1100 structure records

The variant correlation between table variants and tabletop variants is thus described in exactly one simple rule. If a table in the following variation is desired: T-dimensions, 1 x 1; T-style, oak; T-color, light; then a tabletop in the proper variation: P-dimensions, 1 x 1; P-style, oak; P-color, light; will be made automatically via the rule: P- dimensions = T-dimensions (1 m x 1 m); P-style = T-style (oak); P-color = T-color (light). The configuration of the proper legs for the table functions according to the same procedure via the rule between the table and legs.

3. Expert-System-Supported Variant Parts List: Advantage

The elimination of variant expressions from the structure of final products makes possible a sharp reduction of parts list structures. This enhances transparency. Housekeeping can be performed on this basis with the aim of norm-setting and standardization. Uniform structures appear and can be put forth as a standard.

The prospective broadening of variants requires no change in the parts list. The redundancy of structures and data that exists today is eliminated, whereby the cost of managing the parts list is reduced substantially.

Decomposition Logic

The question remains, how, when a particular article (variant = customized design of a final product) is being ordered, the customized, precisely defined parts list is gotten from the constant parts list.

The constant parts list is selected on the basis of the part family of the desired final product and is decomposed by means of the variant expression specific to the customer's order. Rules that can be introduced into the constant parts list at the defined transition from part family heading to part family components enable variable assignment and selection of the specifically required portion of the part family components or the calculation of new values. This can be component dimensions, for example.

Thus, definite identification of the particular final product results upon decomposition. The temporary parts list specific to the customer's order comes from the constant parts list through this process. Expressions that do not exist yet at the instant of decomposition are formed anew and are stored from this instant as additional possible expressions for the product. The plausibility check of expressions for variants, performed in the course of order processing, ensures that no invalid variant codes can occur during parts list decomposition. The drastically reduced number of structures permits interactive parts list decomposition. Thus, the final product can be decomposed during order processing, be scheduled in with regard to capacity, and be checked for feasibility. In addition, bottleneck situations for all resources (equipment, capacity, operating materials) can be identified directly.

APERIA-PPS/L: Production Planning System for Variant Processor; First PPC Standard Software With Rule-Based Software Technology

Aperia Software GmbH + Co KG has implemented the first PPC system having universal rule-based functionality. The PPS/L exhibits for the first time as standard software, elements of expert-system engineering within the IBM/370 architecture among CICS's. Porting to other computers like the IBM AS/400, PC-AT 386, UNIX or DEC-VAX will be implemented in time.

The PPS/L's software architecture ensures the user the desired flexibility in manufacturing scheduling. For instance, the configuration rules of a variant processor in the form of facts and rules can be defined specific to the operation by the professional services unit. The user uses the expert system's simple knowledge editor for this. The combination of the expert system architecture and conventional COBOL programming enables simple operation and high performance.

Positioning in Logical CIM Environment

The PPS/L supports the scheduling information flow from purchasing through production to sales. The concept places logical objectives at the center. The user gains short flow times, high flexibility and enhanced delivery service via

- Expert-system-supported variant management
- Simultaneous multistage on-line network exchange with regard to equipment, capacity and operating materials
- Multistage simulation in the order network, also on-line
- Bottleneck-oriented capacity analysis
- Dual planning for the balancing of sales and material management planning
- Comfortable SAA- [system-application-architecture] conforming user interface

Order networks that include simulation are distinctive features in many conventional PPC systems. Equipment, capacity and operating materials are also planned with an orientation toward bottlenecks here. The PPS/L is open-ended for prospective connection to CAD, BDE [industrial data acquisition] and CNC systems.

Standard Software As Modular System

Additional software modules supplement existing management, material flow and production control functions and close the logical control loop. Modules for purchasing and sales are being implemented. The development team at present is preparing at the conceptual level maintenance as well as quality assurance.

Particular components—the variant configurator—for example, can be integrated on a custom basis into existing PPC designs.

Range of Application

The PPS/L is not just for firms interested in manufacturing engineering. In particular, the technology-oriented production schedule design as well as the optional capacity-dependent management fulfill the requirements of other branches of industry. Firms using sophisticated processes, as well as hybrid organizations, for example, are possible users.

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